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NUMERICAL FORECASTING OF CLEAR AIR TURBULENCE

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ABSTRACT

There is much disagreement as to (a) what causes clear air turbulence (turbulence which is not in or near convective clouds and is above 15,000 feet in altitude) and (b) which meteorological parameters can be used to detect and forecast its occurrence. The approach to this problem has been to relate not one parameter to clear air turbulence but various parameters. By summing these parameters areas can be defined where there is a high probability of encountering clear air turbulence. Each parameter has been based on a statistical study which found a relationship with clear air turbulence. The parameters used were horizontal and vertical shear, curvature, kinetic energy and their derivatives.

The numerical forecasting program proposed here can be extended to the stratosphere when more reliable height and temperature fields are available. This program will have much more significance when intermediate forecast height fields, temperature fields and a grid of much smaller mesh length are available.

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1. INTRODUCTION

The phenomenon of clear air turbulence (henceforth denoted as CAT) appears to consist of random three dimensional eddies that occur in certain confined regions of the atmosphere. This phenomenon was first recognized in the early 1940's as "air pockets", and has gained in importance and depth of study with the development of fast-flying swept wing and delta winged aircraft. It is of prime importance to the aviation industry because it affects the safety and comfort of passengers and crew, as well as operational costs. There have been several cases where loss of control of aircraft, structural damage, passenger and crew injuries (even deaths) have resulted from CAT.

Aircraft manufacturers and the airlines are interested in CAT in order to determine the strength of airframe design so that it can be built to withstand all degrees of turbulence. Planning of supersonic transport aircraft is considering the effects of this unexpected turbulence occurring at any flight level in the atmosphere. Therefore, it becomes an even greater operational problem in the era of future design of SST aircraft as to cost, safety and comfort. CAT is usually less intense than turbulence encountered in thunderstorms 1 . CAT may be considered at times more dangerous than "thunderstorm turbulence" as it usually occurs with no visible warning.

The various military agencies are deeply concerned with the understanding of CAT and its prediction so they may be better prepared to take it into account operationally in all areas of the world. Scientists are highly interested in CAT because it is a phenomenon of our environment that is not clearly understood. We are faced with the problem of having to rely on mesoscale data while the phenomenon is of a microscale. Because of the great differences in scales involved in the forecasting

problem, isolated patches of CAT (in either space or time) are very difficult to identify. It is the intent of this paper to develop a numerical forecasting system of CAT whereby an empirical approach has been used to accomplish this end.

2. DATA COLLECTION

The nature of clear air turbulence, its physics and its meteorology, are still not completely understood. More mesoscale (2km to 100km horizontal distance) and microscale (less than 2km) studies must be made concerning the causes and generation of CAT. Any improvement in forecasting skill that may be realized by this study will probably result from increased mesoscale input data into the forecast problem. The only mesoscale measurements available operationally at this time which concern the problem are rawinsonde data that give a nearly continuous measurement in the vertical of wind, pressure, temperature and humidity from the surface to above 30km in altitude, and satellite cloud pictures that delineate cloud structures down to a scale of about 3km.

The usual definition of CAT is "atmospheric turbulence which is not in or near convective clouds, including thunderstorms, and is not below 15,000 feet in altitude". (4) Thus, mechanical turbulence induced by rough terrain is excluded. It is realized that this is an extremely arbitrary definition resulting from a desire to simplify pilot reporting procedures.

Turbulence intensities are, at present, designated as light, moderate, severe and extreme. In recent years several definitions of the four categories of turbulence have been proposed. The current definitions in official use were developed by the National Advisory Committee for Aeronautics (NACA) Subcommittee on Meteorological Problems (1957). See Table 1.

There are few quantitative measurements of atmospheric turbulence at any scale. The bulk of the aircraft turbulence data available is based upon the four categories stated in Table 1, (4) ; and, consequently is highly subjective and qualitative in nature. Included in the factors that affect the subjective decision of the pilot when reporting turbulence are the wing loading, the aircraft's speed and attitude, the pilot's training, experience, and his psychological reactions (1) .

Objective criteria for turbulence reporting must wait until more measurements are made of the conditions existing in the turbulent eddies, and until cockpit instrumentation includes a gust load or turbulence indicator.

Much time, effort and financial support have been expended in this country by the government, the aircraft industry, and private and public research facilities to investigate the problem of clear air turbulence and to find a good approach leading to a solution to this problem. This research has gone forward in three broad categories: first, research concerning the correlation of CAT with macroscale, mesoscale, and/or microscale atmospheric measurements; second, research into instrumentation for the detection of CAT sufficiently far in advance of the aircraft to allow evasive measures (6) and third, research by military and airline organizations concerning the operational aspects of CAT.

Various projects such as HICAT, ALLCAT, and TOPCAT have been undertaken to study clear air turbulence. The problems encountered were many but the results showed that it was indeed possible, with suitable instrumentation, to find, track and record CAT. The use of constant level ballons and doppler radar to detect CAT has met with some success, but again the lack of detail necessary in CAT studies leaves much to be desired.

Measurements of the microstructure, which contains the perturbations of CAT dimensions (100 to 500 meter wavelength), have been taken by specially instrumented aircraft. Until recently the aircraft itself was used as a sensor to measure atmospheric gusts from the aircraft acceleration data. The Air Force realized the danger of relying solely on the acceleration response of the U-2 aircraft as a measure of turbulence at high altitudes. A full knowledge of the aircraft's response to turbulence over a wide range of wavelengths is required for meaningful interpretation of such data. This procedure usually gives reliable results at short wavelengths up to a few hundred meters. At long wavelengths, this instrumentation becomes less sensitive. Accelerations in longer waves are usually small and can be masked by pilot induced aircraft motions.

A supersonic or hypersonic craft of some radical shape, flying four to ten times the speed of the U-2, will obviously have a somewhat different response to turbulence than the U-2. An aircraft flying at these high speeds would be affected much more by longer turbulence wavelengths and less by the shorter.

As pointed out earlier, the meteorologist has few direct measurements of turbulence intensities and must depend upon the accuracy of the intensities reported by pilots. In our study, we used the Colson monthly turbulence summaries which were obtained from the Air Force 3rd Weather Wing at Offutt AFB, Omaha, Neb. This report suited our needs most closely because the CAT reports were detailed as to location, time, altitude and intensity. In the period used in our study, December 1964 through March 1965, there were no less than 3670 CAT reports. The

reports were located over the United States and extended from about 15,000 feet to over 45,000 feet. The data were collected from military, civilian and private aircraft. They are, as mentioned before, quite subjective.

In the course of this paper three time periods or intervals will be used. It is important to establish at this point which periods were used and for what purpose.

A four month period (December 1964 through March 1965) is used for the research program during which several fields were constructed. Patterns of fields of different meteorological parameters were sometimes similar. Then all but one of them were dropped in our further investigations. In this way only three of the original seven parameters were retained.

The three day period (10 - 12 March, 1965) was used for a verification or correlation study. During this period of time a comparison was made to find out how many times CAT actually occurred in areas where it was predicted.

Finally, 23 February 1965 was arbitrarily chosen from the four month period and used only for illustrating the various fields and parameters used in the research program.

3. THE CLEAR AIR TURBULENCE STUDY

Clear air turbulence (CAT) is a microscale phenomenon (less than 2 kilometers in horizontal extent) but the conditions which are symptomatic of its existence are of snyoptic scale. Therefore, synoptic scale parameters may be used to determine areas where CAT could occur, that is forecasting areas where there is a high probability of CAT.

From various reports and their contradicaions it appears that no single parameter can detect CAT. Certain parameters can detect the possibility of CAT in some synoptic situations but fail in others.

The approach used in this paper was to take statistical studies made by previous investigators and to use the basic parameters which they related to CAT (2,3,5,7,8). If the magnitude of any one parameter becomes large or the sum of various parameters becomes large then there is a high probability of CAT in that area. Therefore, the problem is not one of forecasting actual CAT but rather to forecast areas of high and low probability of encountering CAT. In this way flights may be planned so as to expect least CAT.

The research program consisted of computing the equations shown in Appendix A. These equations were computed using the CDC 1604 digital computer. The program was written utilizing symbolic coded relocatable assembly program (SCRAP). It was necessary to use fixed point fractional numbers in order that Fleet Numerical Weather Facility (FNWF) subroutines could be used. All finite differences were computed using standard FNWF mesh length of 381 kilometers true at 60 degrees north latitude. There are no time derivatives in the program. The research reported here is accomplished using analytical fields. Operational use would employ

forecast fields. Results would naturally not have been as good if forecast fields were used in this research. "Prog 24 hours" printed at the bottom of each field represents the practical forecast interval to be used operationally.

The research program was written to compute CAT in three layers 500 to 300, 300 to 200, and 200 to 100 millibars. Computations were not made for the third layer since 100 millibar fields were not available.

The research program was written to compute on the entire 63 x 63 FNWF grid of the northern hemisphere. A boundary condition of zero was used for the outside rows and columns. The print routines are 22 x 22 extracts of the United States starting at FNWF grid point J008, I018. The latitude and longitude coordinates of the four corners of the printed fields starting with the lower left corner proceeding clockwise are: 9.1N 109.5W, 44.5N 165.[illegible]W, 57.7N 3.1E, 13.0N 58.8W.

All printed fields are pure numbers and have no dimensional meaning. All scaled outputs have been shifted to the left end of the register and the first three numbers with sign bit are printed out in decimal. Grid points can take on values from -.999 to +.999 except those fields which have been made all positive. The decimal point does not appear on the printed fields. Therefore, the printed grid point values are from -999 to +999.

In the research program the capital letters refer to the parameter as computed from the data. The small case letters serving as exponents represent the number of times and direction the register has to be shifted in order to place the significant portion into the first three numbers. Therefore, the two with exponents represent the scaling coefficient. Since the computations were in fixed point fractional all

printouts had to be shifted so as not to exceed one at any grid point in the field. Exceeding one would result in a meaningless value at that particular grid point. In addition the entire field had to be kept large enough so that patterns could exist and not be at or near zero throughout the field. Since these fields are summed they must be small enough so as not to cause the summation field to exceed one at any grid point.

The research program was run for thirty-six days during December 1964 and January, February, and March 1965. The thirty-six days were chosen because they were the most active in CAT reports during the four month period. In other words, there were more reports by pilots encountering CAT on these particular days. In order to show an example of each field printed out by the research program the time 00Z 23 FEB 65 was arbitrarily selected. These fields appear in Appendix C. Each field was produced by an individual term which will be described as follows:

THE FIRST TERM OF THE RESEARCH PROGRAM (APPENDIX A)

The First Term is 2^a A where A is the Laplacian of absolute vortisity. When this term is negative there is a local maximum of absolute vorticity meaning it is larger at that grid point than the average of the surrounding grid points. Therefore, the cyclonic curvature or cyclonic shear or both are relatively large at that grid point. This should correspond to the cold side of the jet especially in throughs. According to Endlich and McLean (1) there is a greater percentage of CAT on the cold side of the jet. Also according to Harrison (2) there is a strong tendency for moderate to severe CAT to be associated with trough lines.

This term was computed for the layer by first calculating the absolute vorticity of the upper and lower level D fields. The Laplacian was then taken of each field and a vertical average made of the upper and lower levels to obtain the Laplacian of vorticity of the layer.

This parameter has depicted most of the CAT associated with the trough over the western United States. The severe CAT near New Orleans is in an area of very large negative numbers. The field is contoured at intervals of 100 with the origin at zero.

THE SECOND TERM

The Second Term is 2^b B where B is the absolute value of the vertical change in the vector thermal wind. One of the parameters which Lake's (7) statistical testing indicated was associated with CAT was the vertical gradient of wind shear. As shown by Richardson (9) the thermal wind shear is proportional to the gradient of static stability.

The u and v components of the thermal wind were computed from the upper and lower level temperature fields. The difference between the upper and lower level values of the u component was found and each difference was squared. This was also done for the v component. The square root of the sum of the squared differences gives the magnitude of the vector difference. According to Endlich and McLean (3) the largest values of the thermal wind shear appear on the warm side of the jet. This was found to be true throughout the four months. The contour interval for this field is 25 and the origin is zero.

THE THIRD TERM

The Third Term is 2^c C where C is one half the geostrophic wind velocity squared. C therefore represents the specific kinetic energy or in other words the kinetic energy per unit mass.

Clem (2) found that most cases of moderate to severe CAT were associated with areas of isotach maxima.

This term was computed for the layer by calculating the u and v components of the geostrophic wind at the upper and lower levels. The upper and lower level u components were vertically averaged to obtain an average u component for the layer. The average v component for the layer was obtained by a similar process. The magnitude of the velocity squared is just the sum of the squared components.

In the research program this field is contoured at intervals of 100 with the origin at zero. Contoured at this interval the kinetic energy field clearly depicts the isotach maxima regions. The kinetic energy field in Appendix C shows this field depicting the CAT in the western part of the United States occurring in areas of relatively large wind speeds. The kinetic energy field fails to indicate the severe CAT near New Orleans because it occurs in an area of relatively light winds.

THE FOURTH TERM

The Fourth Term is 2^d D where D is the absolute value of the derivative of the kinetic energy with respect to pressure.

Lake's (7) statistical testing indicated that the gust intensities are related to the vertical gradients of horizontal kinetic energy. This term was computed for the layer by first calculating the velocity squared at the upper and lower levels. The vertical gradient for the layer was then obtained by computing the difference between the upper and lower level values of the velocity squared. The absolute value was taken so as to have all values positive. CAT should be associated with

large values of this field. Large values of this field were found only in areas of large values of kinetic energy. This field was therefore redundant and was eliminated from the CAT forecast program. The contour interval was 100 with the origin at zero.

THE FIFTH TERM

The Fifth Term is 2^e E where E is the absolute value of the Laplacian of kinetic energy. The statistical survey made by Endlich and McLean (3) shows the maximum occurrence of CAT along the edges of the isotach maxima. The Laplacian of kinetic energy shows large horizontal changes in kinetic energy, both positive and negative. Therefore the absolute value of the term is taken in order to give only positive numbers. The contour interval was 25 with the origin at zero.

This term was introduced to depict the areas of large horizontal change in kinetic energy. However, there was no relationship with reported CAT. This field was therefore eliminated from the CAT forecast program.

THE SIXTH TERM

At this point in the research program it was necessary to sum the first five terms due to computer memory space. This term, referred to as KAT1, was the Sixth Term. The contour interval was 250 with the origin at zero. It was found that this term did not supply significantly new information since it was dominated by the kinetic energy and the two associated terms.

THE SEVENTH TERM

The Seventh Term is 2^f F where F is the Jacobian of temperature and omega (component of the wind normal to the pressure surface). This

term was developed by Dr. Moore of Douglas Aircraft and Dr. Krishnamurti (8). The latter was associated at that time with the University of California, Los Angeles and consultant to Douglas Aircraft. The term was developed as the Jacobian of temperature and three dimensional divergence. As shown in their paper this is proportional to the negative of the Jacobian of temperature and omega. This term was computed for the lower level of each layer in the research program. The contour interval for this term was 100 with the origin at zero. In this program no significant relationship was found with large negative or positive numbers over the four month period. This term was therefore eliminated from the CAT forecast program.

THE EIGHTH TERM

The Eighth Term is 2^g G where G is the absolute value of horizontal divergence. It was computed by taking the derivative of omega with respect to pressure. As previously stated the entrance and exit regions of isotach maxima areas have been found to be associated with CAT. These areas are also associated with horizontal convergence at the entrance and divergence at the exit regions. Therefore the absolute value of the change in omega with pressure represents the convergence and divergence in the layer parallel to the pressure surfaces.

This term was computed by subtracting the lower level omega value from the upper level omega value at each grid point. Areas of convergence and divergence of the height field are quite vividly depicted by the divergence field. No significant relationship was found between the divergence field and the CAT occurrences, therefore, it was eliminated from the CAT forecast program.

THE NINTH TERM

The Ninth Term was KAT2,the summation of all previous terms. No significant relationship was found with CAT occurrences since several terms tended to cancel each other out.

The program then goes into the second layer from 300 to 200 millibars. All terms were computed and scaled the same, except the divergence term. It could not be computed because the 200 millibar omega field was not available.

The third layer from 200 to 100 millibars could not be run for these time periods since the 100 millibar fields were not available. There were very few CAT reports above 200 millibars, therefore, the loss was insignificant.

In all three layers the lower level height field is printed out first. This gives a general impression of the synoptic situation and renders more significance to the patterns developed in the other fields. The contour interval for the 500 millibar field is 60 meters with the origin at 5580 meters. The contour interval for the 300 millibar field is 120 meters with the origin at 9120 meters. The contour interval for the 200 millibar field is 120 meters with the origin at 11,760 meters.

The CAT forecast program appears in Appendix D. The first three terms of the research program are used with minor changes. In the first term "a" is changed to minus one and the contour interval has been changed to 150 to give better defined patterns. The second term has been used unchanged. The third term is unchanged except for the contour interval which was changed to 50 to increase the pattern size. The KAT field itself is the summation of these three terms and gives quite reasonable patterns and pattern sizes.

The pattern area depicting a high probability of CAT would necessarily be larger during a more active CAT period. The most active part of the year was the four month period December 1964, January, February, and March 1965. During these months the most active three day period was the tenth through the twelfth of March 1965. Therefore the KAT fields have quite large pattern sizes in Appendix E since they represent the most active three days of the year. The KAT field patterns were smaller for less active periods. The total area covered by these patterns is much less in the KAT field than in the other three parameter fields.

This is exactly what was attempted in order to obtain optimum size of the forecasted danger areas. If the KAT field patterns are too large, flights will be rerouted unnecessarily. On the other hand, if the KAT field patterns are too small, there is a real danger of CAT occurring outside these areas. Therefore, the restraint of the KAT field patterns is necessary in order to have an operationally useable product.

4. DISCUSSION AND RECOMMENDATION FOR FUTURE STUDIES

The period used in this paper was chosen because of the largest number of reported CAT occurrences. Of the four month period (December 1964, January, February and March 1965) there were scattered periods where a large number of occurrences were reported. This four-month period was used to determine which parameters were best suited for forecasting purposes. The three-day period of 10-12 March 1965 was selected for a correlation study in order to find out how successful our forecast method is. Tables 2, 3, and 4 show the various fields used and the resultant KAT field for the 10^{th}, 11^{th} and 12^{th} of March 1965.

The use of the term "percent correlation" as used in this study does not mean to imply a statistical correlation. The ideal forecast verification makes use of those cases where CAT is forecast, but does not occur, and where CAT is not forecast and does not occur. In our study it was impossible to take those cases quantitatively into account. Therefore, it is to be understood that "correlation" as used in this study was a general comparison of those reported CAT occurrences that fell within the delineated area of high probability of CAT against those that did not. For example, if there were ten reported CAT occurrences for a given layer and time period and six of these reports fell inside or on the line delineating the CAT area and four reports fell outside the area, then for that field, layer and time period we would list it as six occurrences correlated or a sixty percent correlation.

Listed are the names of the fields, the number of occurrences of CAT for each field and the percent correlation by field. Also shown are the number of occurrences and the number of occurrences that correlated by field and CAT intensity.

After combining the Laplacian of Vorticity, Vertical Gradient of Thermal Wind and Kinetic Energy we arrive at the KAT Field which is our end product for the area of high probability of CAT occurrences. Even though a higher correlation may be seen in some fields other than the KAT field, one should realize that these fields encompassed a larger than average area. In such cases one must expect a high correlation.

The high correlation is then not due to the finesse of the forecast method, but rather due to the fact that for most of the USA there was a forecast of high probability for CAT. Theoretically, it would be a good idea to divide the percent correlation (such as we computed) by the size of the area for which CAT was forecasted. We did not follow this idea quantitatively, but only qualitatively. Therefore, one finds that the percent correlation for our ultimate forecast (labeled KAT) is sometimes lower than the percent correlation for one of the three separate forecasting fields.

Table 5 is a summary for the three day period. It shows the total number of CAT occurrences by turbulence category, percent correlation by field and turbulence category, and the three day percent correlation by field.

The results were most encouraging and we feel that our end product was a substantial step in at least the right direction toward forecasting clear air turbulence. Our knowledge of the meso- and micro- structure of flow patterns in the free atmosphere, especially above the tropopause, is still rather poor. A strong need still exists for a well organized and well equipped measurement program, especially at flight levels of the future supersonic transport aircraft. Measurement programs using

methods of data collection other than aircraft should be sought in order to obtain more information on the real micro- structure of the atmosphere, without the large disturbances which a flying aircraft will create itself.

Case studies of CAT occurrences so far were limited to a comparison of turbulence location with atmospheric parameters measured as closely as possible to the time of occurrence. We might gain some additional information on the physical causes of CAT if the development and previous history of flow patterns bearing CAT were studied.

There still exists a need for sensitive, accurate and compact instrumentation, especially an accelerometer which measures and records the three components of gustiness separately and simultaneously.

In summarizing we would like to state that turbulence research in the free atmosphere has come a long way, especially when we consider the fact that measurements are most difficult to duplicate in controlled experiments. We need the free atmosphere above us to conduct our research, and this same atmosphere has an infinite choice of parameter combinations. This should provide the seed of interest to combine the efforts of physics, aerodynamics, mathematics, statistics and meteorology to seek out and find a more complete and more satisfying solution of the problem.

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6. APPENDIX A

EQUATIONS

The numbers in parentheses on this and the following pages refer to the page numbers in the text where each item is discussed.

The numbers below each term in the following two equations identify the number of each term (e.g., KAT1 is the sixth term).

THE RESEARCH PROGRAM (p. 15)

$$\underset{6}{\mathrm{KAT1}} = \underset{1}{2^aA} - \underset{2}{2^bB} - \underset{3}{2^cC} - \underset{4}{2^dD} - \underset{5}{2^eE} \qquad \underset{9}{\mathrm{KAT2}} = \underset{6}{\mathrm{KAT1}} - \underset{7}{2^fF} - \underset{8}{2^gG}$$

THE FIRST TERM 2^aA (p. 15)

$$a = 0 \qquad A = \nabla^2\eta \qquad \eta_0 = f + \frac{g}{fd^2}[Z_1 + Z_2 + Z_3 + Z_4 - 4Z_0]$$

$$\nabla^2\eta_0 = \frac{1}{d^2}[\eta_1 + \eta_2 + \eta_3 + \eta_4 - 4\eta_0] \qquad \nabla^2\eta = 1/2\,[\nabla^2\eta_u + \nabla^2\eta_L]$$

THE SECOND TERM 2^bB (p. 16)

$$b = 0 \qquad B = \left|\frac{\Delta\vec{V}_t}{\Delta P}\right|$$

$$U_t = \frac{-g}{fT}\frac{[T_2 - T_4]}{2d} \qquad V_t = \frac{g}{fT}\frac{[T_3 - T_1]}{2d} \qquad \vec{V}_{t_u} = U_{t_u}i + V_{t_u}j$$

$$\vec{V}_{t_L} = U_{t_L}i + V_{t_L}j \qquad \frac{\Delta\vec{V}_t}{\Delta P} = \frac{\vec{V}_{t_L} - \vec{V}_{t_u}}{\Delta P} = \frac{[U_{t_L}i + V_{t_L}]}{\Delta P} - \frac{[U_{t_L}i + V_{t_L}j]}{\Delta P}$$

$$\frac{\Delta\vec{V}_t}{\Delta P} = \frac{[U_{t_L} - U_{t_u}]}{\Delta P}\, i + \frac{[V_{t_L} - V_{t_u}]}{\Delta P}\, j = \frac{\Delta U_t}{\Delta P}\, i + \frac{\Delta V_t}{\Delta P}\, j$$

$$\left|\frac{\Delta V_t}{\Delta P}\right| = \quad \left(\frac{\Delta U_t}{\Delta P}\right)^2 + \left(\frac{\Delta V_t}{\Delta P}\right)^2$$

THE THIRD TERM $2^c C$ (p. 16)

$$c = 0 \qquad C = \frac{\overline{\vec{V}^2}}{2}$$

$$U_g = \frac{-g}{f}\,\frac{[Z_2 - Z_4]}{2d} \qquad V_g = \frac{g}{f}\,\frac{[Z_3 - Z_1]}{2d}$$

$$\overline{U}_g = \frac{U_{g_u} + U_{g_L}}{2} \qquad \overline{V}_g = \frac{V_{g_u} + V_{g_L}}{2}$$

$$\overline{\vec{V}}_g = \overline{U}_g i + \overline{V}_g j \qquad \overline{\vec{V}^2_g} = (\overline{U}_g)^2 + (\overline{V}_g)^2$$

THE FOURTH TERM $2^d D$ (p. 17)

$$d = 1 \qquad D = \left|\frac{\Delta\frac{\overline{\vec{V}^2}}{2}}{\Delta P}\right|$$

$$\frac{\Delta\overline{\vec{V}^2}}{\Delta P} = \frac{\overline{\vec{V}^2_L} - \overline{\vec{V}^2_u}}{\Delta P} \qquad \left|\frac{\Delta\overline{\vec{V}^2}}{\Delta P}\right| = \sqrt{\left(\frac{\Delta\overline{\vec{V}^2}}{\Delta P}\right)^2}$$

THE FIFTH TERM $2^{e}E$ (p. 18)

$e = 1 \qquad E = |\nabla^2 \frac{\overline{\vec{V}^2}}{2}|$

$$\nabla^2\overline{\vec{V}^2_0} = \frac{1}{d^2}[\overline{\vec{V}^2_1} + \overline{\vec{V}^2_2} + \overline{\vec{V}^2_3} + \overline{\vec{V}^2_4} - 4\overline{\vec{V}^2_0}] \qquad |\nabla^2\overline{\vec{V}^2_0}| = \sqrt{(\nabla^2\overline{\vec{V}^2_0})^2}$$

THE SIXTH TERM (p. 18)

$$KAT1 = \nabla^2\eta - |\frac{\Delta\vec{V}_t}{\Delta P}| - \frac{\overline{\vec{V}^2}}{2} - |\frac{\Delta\overline{\vec{V}^2}}{\Delta P}| - |\nabla^2 \frac{\overline{\vec{V}^2}}{2}|$$

THE SEVENTH TERM $2^{f}F$ (p. 18)

$f = 11 \qquad F = J[T,\omega]$

$$J[T, \nabla_3 \cdot \vec{V}] = \frac{-1}{\gamma P} J[T,\omega]$$

$$J[T,\omega] = \frac{1}{4d^2}[(T_3 - T_1)(\omega_2 - \omega_4) - (T_2 - T_4)(\omega_3 - \omega_1)]$$

THE EIGHTH TERM $2^{g}G$ (p. 19)

$g = 13 \qquad G = |\frac{\Delta\omega}{\Delta P}|$

$$\frac{\Delta\omega}{\Delta P} = \frac{1}{\Delta P}[\omega_L - \omega_u] \qquad |\frac{\Delta\omega}{\Delta P}| = \frac{1}{\Delta P}\sqrt{(\omega_L - \omega_u)^2}$$

THE NINTH TERM (p. 20)

$$KAT2 = KAT1 + 2^{11}\ J[T,\omega] - 2^{13}\left|\frac{\Delta\omega}{\Delta P}\right|$$

PROG KAT PROGRAM (p. 20)

$$KAT = 2^{-1}\ \nabla^2\eta - \left|\frac{\Delta\vec{V}T}{\Delta P}\right| - \frac{\overline{\vec{V}^2}}{2}$$

7. APPENDIX B

THE RESEARCH COMPUTER PROGRAM

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F     00000    50 0 00000
                                    IDENT  ETTEL MORGAN
                                                            CAT FORECAST
                                                            BEGIN STEERING PROGRAM
                                                            COMPUTES 500 TO 300 MB LAYER
               50 0 00000
                    00600           ORG    6003
      00600    20 0 02001           STA    TIME             PUT DATE TIME IN A REGISTER
               50 0 00000
      00601    75 4 00720   START   RTJ    READD2           READS PACKED LOWER LEVEL D FIELD INTO
                                                            FS4
               50 0 00000
      00602    75 4 00726   +       RTJ    UNPCKD2          UNPACKS LOWER LEVEL D FIELD INTO FS1
               50 0 00000
      00603    75 4 00746   +       RTJ    READT2           READS LOWER LEVEL TEMPERATURE FIELD
                                                            INTO FS4
               50 0 00000
      00604    75 4 00754   +       RTJ    UNPCKT2          UNPACKS LOWER LEVEL TEMPERATURE FIELD
                                                            INTO FS3
               50 0 00000
      00605    75 4 00705   +       RTJ    READD1           READS PACKED UPPER LEVEL D FIELD INTO
                                                            FS4
               50 0 00000
      00606    75 4 00713   +       RTJ    UNPCKD1          UNPACKS UPPER LEVEL D FIELD INTO FS0
               50 0 00000
      00607    75 4 00733   +       RTJ    READT1           READS UPPER LEVEL TEMPERATURE FIELD IN
                                                            TO FS4
               50 0 00000
      00610    75 4 00741   +       RTJ    UNPCKT1          UNPACKS UPPER LEVEL TEMPERATURE FIELD
                                                            INTO FS2
               50 0 00000
      00611    75 4 00761   +       RTJ    REWIND           REWINDS TU 3 CH 5/6
               50 0 00000
      00612    75 4 00765   +       RTJ    REWIND1
               50 0 00000
      00613    75 4 01447   +       RTJ    PRINT            PRINTS LOWER HEIGHT FIELD
               50 0 00000
      00614    75 4 00771   +       RTJ    SINE             GENERATES SINE FIELD STOWS IN FS4
               50 0 00000
      00615    75 4 00774   +       RTJ    VORTIS1          COMPUTES VORTICITY FIELD FROM UPPER
                                                            LEVEL D FIELD STOWS IN FS5
               50 0 00000
      00616    75 4 01001   +       RTJ    VORTIS2          COMPUTES VORTICITY FIELD FROM LOWER
                                                            LEVEL D FIELD STOWS IN FS6
               50 0 00000
      00617    75 4 01006   +       RTJ    LAPLAC1          COMPUTES LAPLACIAN OF UPPER LEVEL VORT
                                                            ICITY FIELD STOWS IN FS0
               50 0 00000
```

```
00620   75 4 01014   +   RTJ   LAPLAC2    COMPUTES LAPLACIAN OF LOWER LEVEL VORT
                                          ICITY FIELD STOWS IN FS1
        50 0 00000
00621   75 4 01022   +   RTJ   HORIZ      COMPUTES AVERAGE VORTICITY BETWEEN
                                          UPPER AND LOWER LEVELS STOWS IN FS5
        50 0 00000
00622   75 4 01473   +   RTJ   PRINT1
        50 0 00000
00623   75 4 01027   +   RTJ   MHAT       STOWS SCALED MAP FACTOR IN FS6
        50 0 00000
00624   75 4 01035   +   RTJ   UTHM1      COMPUTES U COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS0
        50 0 00000
00625   75 4 01053   +   RTJ   UTHM2      COMPUTES U COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS1
        50 0 00000
00626   75 4 01071   +   RTJ   DUTHM      COMPUTES U COMPONENT DIFFERANCE
                                          BETWEEN UPPER AND LOWER LEVELS STOWS
                                          IN FS0
        50 0 00000
00627   75 4 01076   +   RTJ   VTHM1      COMPUTES V COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS1
        50 0 00000
00630   75 4 01114   +   RTJ   VTHM2      COMPUTES V COMPONENT OF THERMAL WIND
                                          AT UPPER LEVEL STOWS IN FS2
        50 0 00000
00631   75 4 01132   +   RTJ   DVTHM      COMPUTES V COMPONENT DIFFERANCE
                                          BETWEEM UPPER AND LOWER LEVELS STOWS
                                          IN FS1
        50 0 00000
00632   75 4 01137   +   RTJ   DTHM       COMPUTES VERTICAL GRADIENT OF
                                          THERMAL WIND STOWS IN FS0
        50 0 00000
00633   75 4 01517   +   RTJ   PRINT2
        50 0 00000
00634   75 4 01147   +   RTJ   KAT1       HORIZ MINUS DTHM STOWS IN FS5
        50 0 00000
00635   75 4 00720   +   RTJ   READD2     SEE ABOVE
        50 0 00000
00636   75 4 00726   +   RTJ   UNPCKD2    SEE ABOVE
        50 0 00000
00637   75 4 00705   +   RTJ   READD1     SEE ABOVE
        50 0 00000
00640   75 4 00713   +   RTJ   UNPCKD1    SEE ABOVE
        50 0 00000
00641   75 4 00761   +   RTJ   REWIND     REWINDS TU 3 CH 5/6
        50 0 00000
00642   75 4 00765   +   RTJ   REWIND1
        50 0 00000
```

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00643   75 4 00771    +   RTJ   SINF       SEE ABOVE
        50 0 00000
00644   75 4 01[illegible]27    +   RTJ   MHAT       SEE ABOVE
        50 0 00000
00645   75 4 01154    +   RTJ   UGEOS1     COMPUTES U COMPONENT OF GEOSTROPHIC
                                           WIND AT UPPER LEVEL STOWS IN FS2
        50 0 00000
00646   75 4 01172    +   RTJ   UGEOS2     COMPUTES U COMPONENT OF GEOSTROPHIC
                                           WIND AT LOWER LEVEL STOWS IN FS3
        50 0 00000
00647   75 4 01210    +   RTJ   UGEOS      COMPUTES AVERAGE U COMPONENT STOWS
                                           IN FS2
        50 0 00000
00650   75 4 01217    +   RTJ   VGEOS1     COMPUTES V COMPONENT OF GEOSTROPHIC
                                           WIND AT UPPER LEVEL STOWS IN FS3
        50 0 00000
00651   75 4 01235    +   RTJ   VGEOS2     COMPUTES V COMPONENT OF GEOSTROPHIC
                                           WIND AT LOWER LEVEL STOWS IN FS)
        50 0 00000
00652   75 4 01253    +   RTJ   VGEOS      COMPUTES AVERAGE V COMPONENT STOWS
                                           IN FS0
        50 0 00000
00653   75 4 01262    +   RTJ   KINETIC    COMPUTES V SQUARE STOWS IN FS0
                                           COMPUTES V SQ DIFF STOWS IN FS4
        50 0 00000
00654   75 4 01567    +   RTJ   PRINT4
        50 0 00000
00655   75 4 01613    +   RTJ   PRINT5
        50 0 00000
00656   75 4 01274    +   RTJ   LAPKIN     COMPUTES LAPLACIAN OF KINETIC ENERGY
                                           STOWS IN FS6
        50 0 00000
00657   75 4 01637    +   RTJ   PRINT6
        50 0 00000
00660   75 4 01306    +   RTJ   KAT2       STOWS PREVIOUS TERMS IN FS0
        50 0 00000
00661   75 4 01663    +   RTJ   PRINT7
        50 0 00000
00662   75 4 00746    +   RTJ   READT2     SEE ABOVE
        50 0 00000
00663   75 4 00754    +   RTJ   UNPCKT2    SEE ABOVE
        50 0 00000
00664   75 4 00761    +   RTJ   REWIND     REWINDS TU 3 CH 5/6
        50 0 00000
00665   75 4 01327    +   RTJ   READO2     READS OMEGA FIELD INTO FS4
        50 0 00000
00666   75 4 01335    +   RTJ   UNPCKO2    UNPACKS LOWER LVL OMEGA INTO FS6
        50 0 00000
```

```
00667   75 4 00765   +        RTJ   REWIND1    REWINDS TU2 CH 5/6
        50 0 00000
00670   75 4 01342   +        RTJ   MOORE      COMPUTE, THE JACOBIAN OF TEMPERATURE AND
                                               OMEGA STOWS IN FS1
        50 0 00000
00671   75 4 01314   +        RTJ   READ01     READS OMEGA FIELD INTO FS4
        50 0 00000
00672   75 4 01322   +        RTJ   UNPCK01    UNPACKS UPPER LVL OMEGA INTO FS5
        50 0 00000
00673   75 4 00765   +        RTJ   REWIND1
        50 0 00000
00674   75 4 01355   +        RTJ   HORDVG     COMPUTE, HORIZONTAL DIVERGENCE STOWS FS5
        50 0 00000
00675   75 4 01365   +        RTJ   ABSDIV     COMPUTES ABSOLUTE DIVERG STOWS IN FS5
        50 0 00000
00676   75 4 01707   +        RTJ   PRINT8
        50 0 00000
00677   75 4 01543   +        RTJ   PRINT3
        50 0 00000
00700   75 4 01373   +        RTJ   KAT        COMPUTES VORTICITY DIFFERANCE PLUS
                                               THERMAL WIND DIFFERANCE PLUS KINETIC
                                               ENERGY DIFFERANCE PLUS THE CHANGE IN
                                               KINETIC ENERGY PLUS KINETIC ENERGY
                                               PLUS THE DIVERGENCE
        50 0 00000
00701   75 4 01663   +        RTJ   PRINT7
        50 0 00000
00702   75 4 01400   +        RTJ   LAYER2     COMPUTES 300 TO 200 MB LAYER
        50 0 00000
00703   75 4 01424   +        RTJ   LAYER3     COMPUTES 200 TO 100 MB LAYER
        50 0 00000
00704   76 0 00000   +        SLS              END OF STEERING PROGRAM USES OFF LINE
                                               PRINTING
        50 0 00000
00705   75 0 00000   READ01   SLJ   **
        50 0 00000
00706   12 0 02701   +        LDA   TIME
        14 0 01735            LLG   NAME1
00707   75 4 04231   +        RTJ   MAG
        00 0 00000            00    0,0
00710   50 0 02014   HIGHD    ENI   MAA
        50 0 01300            ENI   1300B
00711   50 0 44215            ENI   FS4
        50 0 02307            ENI   READERR
00712   75 0 00705            SLJ   READ01
        50 0 00000
00713   75 0 00000   UNPCK 1  SLJ   **
        50 6 00000            ENI   0,6
```

```
00714    75 0 00716     +         SLJ    *+2
         00 0 44215               00     FS4
00715    00 0 05015               00     FS3
         00 0 02453               00     24533B
00716    75 4 04715     +         RTJ    WAB
         50 0 00007               ENI    7
00717    75 0 00713               SLJ    UNPCKD1
         50 0 00000
00720    75 0 00000     READD2    SLJ    **
         50 0 00000
00721    12 0 02001     +         LDA    TIME
         16 0 01740               LDQ    NAME2
00722    75 4 04231     +         RTJ    MAG
         00 0 00000               00     0,0
00723    50 0 02014               ENI    MAA
         50 0 01300               ENI    1300B
00724    50 0 44215               ENI    FS4
         50 0 02007               ENI    READERR
00725    75 0 00720               SLJ    READD2
         50 0 00000
00726    75 0 00000     UNPCKD2   SLJ    **
         50 6 00000               ENI    0,6
00727    75 0 00731     +         SLJ    *+2
         00 0 44215               00     FS4
00730    00 0 14655               00     FS1
         00 0 02453               00     24533B
00731    75 4 04715     +         RTJ    WAB
         50 0 00007               ENI    7
00732    75 0 00726               SLJ    UNPCKD2
         50 0 00000
00733    75 0 00000     READT1    SLJ    **
         50 0 00000
00734    12 0 02001     +         LDA    TIME
         16 0 01743               LDQ    NAME3
00735    75 4 04231     +         RTJ    MAG
         00 0 00000               00     0,0
00736    50 0 02014     HIGHT     ENI    MAA
         50 0 01300               ENI    1300B
00737    50 0 44215               ENI    FS4
         50 0 02007               ENI    READERR
00740    75 0 00733               SLJ    READT1
         50 0 00000
00741    75 0 00000     UNPCKT1   SLJ    **
         50 6 00000               ENI    0,6
00742    75 0 00744     +         SLJ    *+2
         00 0 44215               00     FS4
00743    00 0 24515               00     FS2
         00 0 02453               00     24533B
```

```
00744   75 4 04715   +         RTJ   WAB
        50 0 00007             ENI   7

00745   75 0 00741             SLJ   UNPCKT1
        50 0 00000

00746   75 0 00000   READT2    SLJ   **
        50 0 00000

00747   12 0 02001   +         LDA   TIME
        16 0 01746             LDQ   NAME4

00750   75 4 04231   +         RTJ   MAG
        00 0 00000             00    0,0

00751   50 0 02014             ENI   MAA
        50 0 01300             ENI   1300B

00752   50 0 44215             ENI   FS4
        50 0 02007             ENI   READERR

00753   75 0 00746             SLJ   READT2
        50 0 00000

00754   75 0 00000   UNPCKT2   SLJ   **
        50 6 00000             ENI   0,6

00755   75 0 00757   +         SLJ   *+2
        00 0 44215             00    FS4

00756   00 0 34355             00    FS3
        00 0 02453             00    2453B

00757   75 4 04715   +         RTJ   WAB
        50 0 00007             ENI   7

00760   75 0 00754             SLJ   UNPCKT2
        50 0 00000

00761   75 0 00000   REWIND    SLJ   **
        50 0 00000

00762   75 4 02014   +         RTJ   MAA
        00 0 11306             00    11306B

00763   75 0 00761   +         SLJ   REWIND
        50 0 00000

00764   75 0 02013   +         SLJ   WINDERR
        50 0 00000

00765   75 0 00000   REWIND1   SLJ   **
        50 0 00000

00766   75 4 02014   +         RTJ   MAA
        00 0 11206             00    11206B

00767   75 0 00765   +         SLJ   REWIND1
        50 0 00000

00770   75 0 02013   +         SLJ   WINDERR
        50 0 00000

00771   75 0 00000   SINF      SLJ   **
        50 0 00000

00772   75 4 04535   +         RTJ   SAI
        50 0 44215             ENI   FS4

00773   75 0 00771   +         SLJ   SINF
        50 0 00000
```

```
00774   75 0 00000   VORTIS1  SLJ   **
        50 0 00000
00775   75 4 04611   +        RTJ   SAR
        50 0 44215            ENI   FS4
00776   50 0 05015            ENI   FS0
        50 0 54055            ENI   FS5
00777   50 0 02011            ENI   VORTER1
        50 0 04451            ENI   SAH
01000   75 0 00774            SLJ   VORTIS1
        50 0 00000
01001   75 0 00000   VORTIS2  SLJ   **
        50 0 00000
01002   75 4 04611   +        RTJ   SAR
        50 0 44215            ENI   FS4
01003   50 0 14655            ENI   FS1
        50 0 63715            ENI   FS6
01004   50 0 02012            ENI   VORTER2
        50 0 04451            ENI   SAH
01005   75 0 01001            SLJ   VORTIS2
        50 0 00000
01006   75 0 00000   LAPLAC1  SLJ   **
        50 0 00000
01007   75 4 04423   +        RTJ   SAD
        00 0 05015            00    FS0
01010   00 0 54055            00    FS5
        00 0 02004            00    LAPERR1
01011   75 4 04451   +        RTJ   SAH
        50 0 04447            ENI   SAD+24B
01012   50 0 04435            ENI   SAD+12B
        50 0 04435            ENI   SAD+12B
01013   75 0 01006            SLJ   LAPLAC1
        50 0 00000
01014   75 0 00000   LAPLAC2  SLJ   **
        50 0 00000
01015   75 4 04423   +        RTJ   SAD
        00 0 14655            00    FS1
01016   00 0 63715            00    FS6
        00 0 02005            00    LAPERR2
01017   75 4 04451   +        RTJ   SAH
        50 0 04447            ENI   SAD+24B
01020   50 0 04435            ENI   SAD+12B
        50 0 04435            ENI   SAD+12B
01021   75 0 01014            SLJ   LAPLAC2
        50 0 00000
01022   75 0 00000   HORIZ    SLJ   **
        50 4 00000            ENI   0,4
01023   12 4 05015   LOOP1    LDA   FS0,4
        14 4 14655            ADD   FS1,4
```

```
01024   20 4 54055               STA    FS5,4
        50 0 00000

01025   54 4 07600     +         ISK    7600B,4
        75 0 01023               SLJ    LOOP1

01026   75 0 01022               SLJ    HORIZ
        50 0 00000

01027   75 0 00000     MHAT      SLJ    **
        50 0 00000

01030   75 4 04570     +         RTJ    SAJ
        00 0 02002               00     HATERR

01031   50 0 44215               ENI    FS4
        50 0 63715               ENI    FS6

01032   75 4 04451     +         RTJ    SAH
        00 0 04577               00     SAJ+7B

01033   50 0 04577               ENI    SAJ+7B
        50 0 04577               ENI    SAJ+7B

01034   75 0 01027               SLJ    MHAT
        50 0 00000

01035   75 0 00000     UTHM1     SLJ    **
        50 0 00000

01036   75 4 04451     DIF1      RTJ    SAH
        00 0 01041               00     OUTSID1

01037   50 0 01043     +         ENI    INSID1
        50 0 01043               ENI    INSID1

01040   75 0 01035     +         SLJ    UTHM1
        50 0 00000

01041   10 0 00000     OUTSID1   ENA    0
        20 2 05015               STA    FS0,2

01042   75 0 01036               SLJ    DIF1
        50 0 00000

01043   12 2 44215     INSID1    LDA    FS4,2
        01 0 00001               ARS    1

01044   14 0 01733               ADD    CONST1
        20 0 01775               STA    LOCAT1

01045   26 0 01775               MUF    LOCAT1
        20 0 01775               STA    LOCAT1

01046   12 3 24515               LDA    FS2,3
        15 1 24515               SUB    FS2,1

01047   20 0 01776               STA    LOCAT2
        12 0 01734               LDA    CONST2

01050   26 2 63715               MUF    FS6,2
        26 0 01776               MUF    LOCAT2

01051   27 0 01775               DVF    LOCAT1
        27 2 24515               DVF    FS2,2

01052   20 2 05015               STA    FS0,2
        75 0 01036               SLJ    DIF1

01053   75 0 00000     UTHM2     SLJ    **
        50 0 00000
```

```
01054   75 4 04451      DIF2      RTJ   SAH
        00 0 01057                00    OUTSID2

01055   50 0 01061      +         ENI   INSID2
        50 0 01061                ENI   INSID2

01056   75 0 01053      +         SLJ   UTHM2
        50 0 00000

01057   10 0 00000      OUTSID2   ENA   0
        20 2 14655                STA   FS1,2

01060   75 0 01054                SLJ   DIF2
        50 0 00000

01061   12 2 44215      INSID2    LDA   FS4,2
        01 0 00001                ARS   1

01062   14 0 01733                ADD   CONST1
        20 0 01775                STA   LOCAT1

01063   26 0 01775                MUF   LOCAT1
        20 0 01775                STA   LOCAT1

01064   12 3 34355                LDA   FS3,3
        15 1 34355                SUB   FS3,1

01065   20 0 01776                STA   LOCAT2
        12 0 01734                LDA   CONST2

01066   26 2 63715                MUF   FS6,2
        26 0 01776                MUF   LOCAT2

01067   27 0 01775                DVF   LOCAT1
        27 2 34355                DVF   FS3,2

01070   20 2 14655                STA   FS1,2
        75 0 01054                SLJ   DIF2

01071   75 0 00000      DUTHM     SLJ   **
        50 4 00000                ENI   0,4

01072   12 4 05015      LOOP4     LDA   FS0,4
        15 4 14655                SUB   FS1,4

01073   20 4 05015                STA   FS0,4
        50 0 00000

01074   54 4 07600      +         ISK   7600B,4
        75 0 01072                SLJ   LOOP4

01075   75 0 01071                SLJ   DUTHM
        50 0 00000

01076   75 0 00000      VTHM1     SLJ   **
        50 0 00000

01077   75 4 04451      DIF3      RTJ   SAH
        00 0 01102                00    OUTSID3

01100   50 0 01104      +         ENI   INSID3
        50 0 01104                ENI   INSID3

01101   75 0 01076      +         SLJ   VTHM1
        50 0 00000

01102   10 0 00000      OUTSID3   ENA   0
        20 2 14655                STA   FS1,2

01103   75 0 01077                SLJ   DIF3
        50 0 00000
```

```
01104   12 2 44215    INSID3   LDA   FS4,2
        01 0 00001             ARS   1
01105   14 0 01733             ADD   CONST1
        20 0 01775             STA   LOCAT1
01106   26 0 01775             MUF   LOCAT1
        20 0 01775             STA   LOCAT1
01107   12 2 24516             LDA   FS2+1,2
        15 2 24514             SUB   FS2-1,2
01110   20 0 01776             STA   LOCAT2
        12 0 01734             LDA   CONST2
01111   26 2 63715             MUF   FS6,2
        26 0 01776             MUF   LOCAT2
01112   27 0 01775             DVF   LOCAT1
        27 2 24515             DVF   FS2,2
01113   20 2 14655             STA   FS1,2
        75 0 01077             SLJ   DIF3
01114   75 0 00000    VTHM2    SLJ   **
        50 0 00000
01115   75 4 04451    DIF4     RTJ   SAH
        00 0 01120             +0    OUTSID4
01116   50 0 01122    +        ENI   INSID4
        50 0 01122             ENI   INSID4
01117   75 0 01114    +        SLJ   VTHM2
        50 0 00000
01120   10 0 00000    OUTSID4  ENA   0
        20 2 24515             STA   FS2,2
01121   75 0 01115             SLJ   DIF4
        50 0 00000
01122   12 2 44215    INSID4   LDA   FS4,2
        01 0 00001             ARS   1
01123   14 0 01733             ADD   CONST1
        20 0 01775             STA   LOCAT1
01124   26 0 01775             MUF   LOCAT1
        20 0 01775             STA   LOCAT1
01125   12 2 34356             LDA   FS3+1,2
        15 2 34354             SUB   FS3-1,2
01126   20 0 01776             STA   LOCAT2
        12 0 01734             LDA   CONST2
01127   26 2 63715             MUF   FS6,2
        26 0 01776             MUF   LOCAT2
01130   27 0 01775             DVF   LOCAT1
        27 2 34355             DVF   FS3,2
01131   20 2 24515             STA   FS2,2
        75 0 01115             SLJ   DIF4
01132   75 0 00000    DVTHM    SLJ   **
        50 4 00000             ENI   0,4
01133   12 4 24515    LOOP7    LDA   FS2,4
        15 4 14655             SUB   FS1,4
```

```
01134   20 4 14655             STA   FS1,4
        50 0 00000
01135   54 4 07600   +         ISK   7600B,4
        75 0 01133             SLJ   LOOP7
01136   75 0 01132             SLJ   DVTHM
        50 0 00000
01137   75 0 00000   DTHM      SLJ   **
        50 4 00000             ENI   0,4
01140   12 4 05015   LOOP8     LDA   FS0,4
        26 4 05015             MUF   FS0,4
01141   20 4 05015             STA   FS0,4
        12 4 14655             LDA   FS1,4
01142   26 4 14655             MUF   FS1,4
        14 4 05015             ADD   FS0,4
01143   75 4 04666   +         RTJ   VAB
        00 0 02017             00    SQERR
01144   20 4 05015   +         STA   FS0,4
        50 0 00000
01145   54 4 07600   +         ISK   7600B,4
        75 0 01140             SLJ   LOOP8
01146   75 0 01137             SLJ   DTHM
        50 0 00000
01147   75 0 00000   KAT1      SLJ   **
        50 4 00000             ENI   0,4
01150   12 4 54055   LOOP9     LDA   FS5,4
        15 4 05015             SUB   FS0,4
01151   20 4 54055             STA   FS5,4
        50 0 00000
01152   54 4 07600   +         ISK   7600B,4
        75 0 01150             SLJ   LOOP9
01153   75 0 01147             SLJ   KAT1
        50 0 00000
01154   75 0 00000   UGEOS1    SLJ   **
        50 0 00000
01155   75 4 04451   DIF5      RTJ   SAH
        00 0 01160             00    OUTSID5
01156   50 0 01162   +         ENI   INSID5
        50 0 01162             ENI   INSID5
01157   75 0 01154   +         SLJ   UGEOS1
        50 0 00000
01160   10 0 00000   OUTSID5   ENA   0
        20 2 24515             STA   FS2,2
01161   75 0 01155             SLJ   DIF5
        50 0 00000
01162   12 2 44215   INSID5    LDA   FS4,2
        01 0 00001             ARS   1
01163   14 0 01733             ADD   CONST1
        20 0 01775             STA   LOCAT1
```

```
01164   26 0 01775             MUF   LOCAT1
        20 0 01775             STA   LOCAT1
01165   12 3 05015             LDA   FS0,3
        15 1 05015             SUB   FS0,1
01166   20 0 01776             STA   LOCAT2
        12 0 01734             LDA   CONST2
01167   26 2 63715             MUF   FS6,2
        26 0 01776             MUF   LOCAT2
01170   27 0 01775             DVF   LOCAT1
        20 2 24515             STA   FS2,2
01171   75 0 01155             SLJ   DIF5
        50 0 00000
01172   75 0 00000   UGEOS2    SLJ   **
        50 0 00000
01173   75 4 04451   DIF6      RTJ   SAH
        00 0 01176             00    OUTSID6
01174   50 0 01200   +         ENI   INSID6
        50 0 01200             ENI   INSID6
01175   75 0 01172   +         SLJ   UGEOS2
        50 0 00000
01176   10 0 00000   OUTSID6   ENA   0
        20 2 34355             STA   FS3,2
01177   75 0 01173             SLJ   DIF6
        50 0 00000
01200   12 2 44215   INSID6    LDA   FS4,2
        01 0 00001             ARS   1
01201   14 0 01733             ADD   CONST1
        20 0 01775             STA   LOCAT1
01202   26 0 01775             MUF   LOCAT1
        20 0 01775             STA   LOCAT1
01203   12 3 14655             LDA   FS1,3
        15 1 14655             SUB   FS1,1
01204   20 0 01776             STA   LOCAT2
        12 0 01734             LDA   CONST2
01205   26 2 63715             MUF   FS6,2
        26 0 01776             MUF   LOCAT2
01206   27 0 01775             DVF   LOCAT1
        20 2 34355             STA   FS3,2
01207   75 0 01173             SLJ   DIF6
        50 0 00000
01210   75 0 00000   UGEOS     SLJ   **
        50 4 00000             ENI   0,4
01211   12 4 24515   LOOP10    LDA   FS2,4
        05 0 00003             ALS   3
01212   20 0 01775             STA   LOCAT1
        12 4 34355             LDA   FS3,4
01213   05 0 00003             ALS   3
        14 0 01775             ADD   LOCAT1
```

```
01214   20 4 24515             STA    FS2,4
        50 0 00000
01215   54 4 07600   +         ISK    7600B,4
        75 0 01211             SLJ    LOOP10
01216   75 0 01210             SLJ    UGFOS
        50 0 00000
01217   75 0 00000   VGEOS1    SLJ    **
        50 0 00000
01220   75 4 04451   DIF7      RTJ    SAH
        00 0 01223             00     OUTSID7
01221   50 0 01225   +         ENI    INSID7
        50 0 01225             ENI    INSID7
01222   75 0 01217   +         SLJ    VGEOS1
        50 0 00000
01223   10 0 00000   OUTSID7   ENA    0
        20 2 34355             STA    FS3,2
01224   75 0 01220             SLJ    DIF7
        50 0 00000
01225   12 2 44215   INSID7    LDA    FS4,2
        01 0 00001             ARS    1
01226   14 0 01733             ADD    CONST1
        20 0 01775             STA    LOCAT1
01227   26 0 01775             MUF    LOCAT1
        20 0 01775             STA    LOCAT1
01230   12 2 05016             LDA    FS0+1,2
        15 2 05014             SUB    FS0-1,2
01231   20 0 01776             STA    LOCAT2
        12 0 01734             LDA    CONST2
01232   26 2 63715             MUF    FS6,2
        26 0 01776             MUF    LOCAT2
01233   27 0 01775             DVF    LOCAT1
        20 2 34355             STA    FS3,2
01234   75 0 01220             SLJ    DIF7
        50 0 00000
01235   75 0 00000   VGEOS2    SLJ    **
        50 0 00000
01236   75 4 04451   DIF8      RTJ    SAH
        00 0 01241             00     OUTSID8
01237   50 0 01243   +         ENI    INSID8
        50 0 01243             ENI    INSID8
01240   75 0 01235   +         SLJ    VGEOS2
        50 0 00000
01241   10 0 00000   OUTSID8   ENA    0
        20 2 05015             STA    FS0,2
01242   75 0 01236             SLJ    DIF8
        50 0 00000
01243   12 2 44215   INSID8    LDA    FS4,2
        01 0 00001             ARS    1
```

```
01244   14 0 01733            ADD   CONST1
        20 0 01775            STA   LOCAT1

01245   26 0 01775            MUF   LOCAT1
        20 0 01775            STA   LOCAT1

01246   12 2 14556            LDA   FS1+1,2
        15 2 14654            SUB   FS1-1,2

01247   20 0 01776            STA   LOCAT2
        12 0 01734            LDA   CONST2

01250   26 2 63715            MUF   FS6,2
        26 0 01776            MUF   LOCAT2

01251   27 0 01775            DVF   LOCAT1
        20 2 05015            STA   FS0,2

01252   75 0 01236            SLJ   DIF8
        50 0 00000

01253   75 0 00000   VGEOS    SLJ   **
        50 4 00000            ENI   0,4

01254   12 4 34355   LOOP11   LDA   FS3,4
        05 0 00003            ALS   3

01255   20 0 01775            STA   LOCAT1
        12 4 05015            LDA   FS0,4

01256   05 0 00003            ALS   3
        14 0 01775            ADD   LOCAT1

01257   20 4 05015            STA   FS0,4
        50 0 00000

01260   54 4 07600   +        ISK   7600B,4
        75 0 01254            SLJ   LOOP11

01261   75 0 01253            SLJ   VGEOS
        50 0 00000

01262   75 0 00000   KINETIC  SLJ   **
        50 4 00000            ENI   0,4

01263   12 4 24515   LOOP12   LDA   FS2,4
        26 4 24515            MUF   FS2,4

01264   20 0 01775            STA   LOCAT1
        12 4 05015            LDA   FS0,4

01265   26 4 05015            MUF   FS0,4
        20 0 01776            STA   LOCAT2

01266   14 0 01775            ADD   LOCAT1
        01 0 00001            ARS   1

01267   20 4 05015            STA   FS0,4
        12 0 01775            LDA   LOCAT1

01270   15 0 01776            SUB   LOCAT2
        20 4 44215            STA   FS4,4

01271   26 4 44215            MUF   FS4,4
        20 4 44215            STA   FS4,4

01272   54 4 07600   +        ISK   7600B,4
        75 0 01263            SLJ   LOOP12

01273   75 0 01262            SLJ   KINETIC
        50 0 00000
```

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01274   75 0 00000   LAPKIN   SLJ   **
        50 0 00000
01275   75 4 04423   +        RTJ   SAD
        00 0 63715            00    FS6
01276   00 0 05015            00    FS0
        00 0 02006            00    LAPERR3
01277   75 4 04451   +        RTJ   SAH
        50 0 04447            ENI   SAD+24B
01300   50 0 04435            ENI   SAD+12B
        50 0 04435            ENI   SAD+12B
01301   50 4 00000            ENI   0,4
        50 0 00000
01302   12 4 63715   ABS      LDA   FS6,4
        26 4 63715            MUF   FS6,4
01303   20 4 63715            STA   FS6,4
        50 0 00000
01304   54 4 07600   +        ISK   7600B,4
        75 0 01302            SLJ   ABS
01305   75 0 01274            SLJ   LAPKIN
        50 0 00000
01306   75 0 00000   KAT2     SLJ   **
        50 4 00000            ENI   0,4
01307   12 4 54055   LOOP13   LDA   FS5,4
        15 4 05015            SUB   FS0,4
01310   15 4 63715            SUB   FS6,4
        15 4 44215            SUB   FS4,4
01311   20 4 05015            STA   FS0,4
        50 0 00000
01312   54 4 07600   +        ISK   7600B,4
        75 0 01307            SLJ   LOOP13
01313   75 0 01306            SLJ   KAT2
        50 0 00000
01314   75 0 00000   READ01   SLJ   **
        50 0 00000
01315   12 0 02001   +        LDA   TIME
        16 0 01751            LDQ   NAME5
01316   75 4 04231   +        RTJ   MAG
        00 0 00000            00    0,0
01317   50 0 02014            ENI   MAA
        50 0 01200            ENI   1200B
01320   50 0 44215            ENI   FS4
        50 0 02007            ENI   READERR
01321   75 0 01314            SLJ   READ01
        50 0 00000
01322   75 0 00000   UNPCK01  SLJ   **
        50 6 00000            ENI   0,6
01323   75 0 01325   +        SLJ   *+2
        00 0 44215            00    FS4
```

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01324   00 0 54055          00    FS5
        00 0 02453          00    2453B

01325   75 4 04715   +      RTJ   WAB
        50 0 00007          ENI   7

01326   75 0 01322          SLJ   UNPCK01
        50 0 00000

01327   75 0 00000  READ02  SLJ   **
        50 0 00000

01330   12 0 02001   +      LDA   TIMF
        16 0 01754          LDQ   NAME6

01331   75 4 04231   +      RTJ   MAG
        00 0 00000          00    0,0

01332   50 0 02014          ENI   MAA
        50 0 01200          ENI   1200B

01333   50 0 44215          ENI   FS4
        50 0 02007          ENI   READERR

01334   75 0 01327          SLJ   READ02
        50 0 00000

01335   75 0 00000 UNPCK02  SLJ   **
        50 6 00000          ENI   0,6

01336   75 0 01340   +      SLJ   *+2
        00 0 44215          00    FS4

01337   00 0 63715          00    FS6
        00 0 02453          00    2453B

01340   75 4 04715   +      RTJ   WAB
        50 0 00007          ENI   7

01341   75 0 01335          SLJ   UNPCK02
        50 0 00000

01342   75 0 00000  MOORE   SLJ   **
        50 0 00000

01343   75 4 04371   +      RTJ   SAB
        00 0 14655          00    FS1

01344   00 0 34355          00    FS3
        00 0 63715          00    FS6

01345   00 0 00000   +      00    0
        00 0 02003          00    JACERR

01346   75 4 04451   +      RTJ   SAH
        50 0 04420          ENI   SAB+27B

01347   50 0 04406   +      ENI   SAB+15B
        50 0 04406          ENI   SAB+15B

01350   50 4 00000          ENI   0,4
        50 0 00000

01351   12 4 14655  SHIFT   LDA   FS1,4
        05 0 00013          ALS   11

01352   20 4 14655          STA   FS1,4
        50 0 00000

01353   54 4 07600   +      ISK   7600B,4
        75 0 01351          SLJ   SHIFT
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01354   75 0 01342             SLJ    MOORE
        50 0 00000
01355   75 0 00000   HORDVG    SLJ    **
        50 4 00000             ENI    0,4
01356   12 4 54055   LOOP15    LDA    FS5,4
        01 0 00001             ARS    1
01357   20 0 01775             STA    LOCAT1
        12 4 63715             LDA    FS6,4
01360   01 0 00001             ARS    1
        20 0 01776             STA    LOCAT2
01361   12 0 01775             LDA    LOCAT1
        15 0 01776             SUB    LOCAT2
01362   20 4 54055             STA    FS5,4
        50 0 00000
01363   54 4 07600   +         ISK    7600B,4
        75 0 01356             SLJ    LOOP15
01364   75 0 01355             SLJ    HORDVG
        50 0 00000
01365   75 0 00000   ABSDIV    SLJ    **
        50 4 00000             ENI    0,4
01366   12 4 54055   LOOP17    LDA    FS5,4
        26 4 54055             MUF    FS5,4
01367   05 0 00016             ALS    14
        50 0 00000
01370   20 4 54055   +         STA    FS5,4
        50 0 00000
01371   54 4 07600   +         ISK    7600B,4
        75 0 01366             SLJ    LOOP17
01372   75 0 01365             SLJ    ABSDIV
        50 0 00000
01373   75 0 00000   KAT       SLJ    **
        50 4 00000             ENI    0,4
01374   12 4 05015   LOOP16    LDA    FS0,4
        15 4 54055             SUB    FS5,4
01375   15 4 14655             SUB    FS1,4
        20 4 05015             STA    FS0,4
01376   54 4 07600   +         ISK    7600B,4
        75 0 01374             SLJ    LOOP16
01377   75 0 01373             SLJ    KAT
        50 0 00000
01400   75 0 00000   LAYER2    SLJ    **
        12 0 01757             LDA    COUNT
01401   05 0 00001             ALS    1
        20 0 01757             STA    COUNT
01402   22 3 01400             AJPM   LAYER2
        12 0 01736             LDA    NAME1A
01403   20 0 01735             STA    NAME1
        12 0 01741             LDA    NAME2A
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01404   20 0 01740             STA   NAME2
        12 0 01744             LDA   NAME3A
01405   20 0 01743             STA   NAME3
        12 0 01747             LDA   NAME4A
01406   20 0 01746             STA   NAME4
        12 0 01755             LDA   NAME6A
01407   20 0 01754             STA   NAME6
        12 0 01761             LDA   LEVEL2
01410   20 0 01471             STA   TITLE+3
        20 0 01515             STA   TITLE1+3
01411   20 0 01541             STA   TITLE2+3
        20 0 01565             STA   TITLE3+3
01412   20 0 01611             STA   TITLE4+3
        20 0 01635             STA   TITLE5+3
01413   20 0 01661             STA   TITLE6+3
        20 0 01705             STA   TITLE7+3
01414   20 0 01731             STA   TITLE8+3
        12 0 01763             LDA   A2
01415   20 0 01461             STA   A1
        12 0 01765             LDA   B2
01416   20 0 01462             STA   B1
        12 0 01767             LDA   C2
01417   20 0 01464             STA   C1
        12 0 01771             LDA   D2
01420   20 0 01463             STA   D1
        12 0 01773             LDA   E2
01421   61 0 01460             SAL   E1
        12 0 01777             LDA   TAPUNIT
01422   61 0 00710             SAL   HIGHD
        61 0 00736             SAL   HIGHT
01423   75 0 00601             SLJ   START
        50 0 00000
01424   75 0 00000   LAYER3    SLJ   **
        12 0 01760             LDA   COUNT1
01425   05 0 00001             ALS   1
        20 0 01760             STA   COUNT1
01426   22 3 01424             AJPM  LAYER3
        12 0 01737             LDA   NAME1B
01427   20 0 01735             STA   NAME1
        12 0 01742             LDA   NAME2B
01430   20 0 01740             STA   NAME2
        12 0 01745             LDA   NAME3B
01431   20 0 01743             STA   NAME3
        12 0 01750             LDA   NAME4B
01432   20 0 01746             STA   NAME4
        12 0 01753             LDA   NAME5B
01433   20 0 01751             STA   NAME5
        12 0 01756             LDA   NAME6B
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01434   20 0 01754              STA   NAME6
        12 0 01762              LDA   LEVEL3
01435   20 0 01471              STA   TITLE+3
        20 0 01515              STA   TITLE1+3
01436   20 0 01541              STA   TITLE2+3
        20 0 01565              STA   TITLE3+3
01437   20 0 01611              STA   TITLE4+3
        20 0 01635              STA   TITLE5+3
01440   20 0 01661              STA   TITLE6+3
        20 0 01705              STA   TITLE7+3
01441   20 0 01731              STA   TITLE8+3
        12 0 01764              LDA   A3
01442   20 0 01461              STA   A1
        12 0 01766              LDA   B3
01443   20 0 01462              STA   B1
        12 0 01770              LDA   C3
01444   20 0 01464              STA   C1
        12 0 01772              LDA   D3
01445   20 0 01463              STA   D1
        12 0 01774              LDA   E3
01446   61 0 01460              SAL   E1
        75 0 00601              SLJ   START
01447   75 0 00000    PRINT     SLJ   **
        10 0 00012              ENA   10
01450   20 0 00017              STA   17B
        50 0 00000
01451   75 0 01455    +         SLJ   *+4
        00 0 00000              00    0
01452   00 0 14655              00    FS1
        00 0 63715              00    FS6
01453   00 0 00047              00    39
        00 0 00035              00    29
01454   00 0 00022              00    18
        00 0 00010              00    8
01455   75 4 04745    +         RTJ   WAE
        00 0 00000              00    0
01456   75 4 02524    +         RTJ   MAC
        00 0 63715              00    FS6,0
01457   75 0 01447    +         SLJ   PRINT
        77 7 63715              77    FS6,7
01460   10 0 02000    E1        10    TAU
        00 0 00004              00    4
01461   13 1 11710    A1        OCT   1311171047640243
        47 6 40243
01462   02 4 76132    B1        OCT   0247613261070664
        61 0 70664
01463   00 1 42600    D1        OCT   0014260000000000
        00 0 00000
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01464   01 3 56300   C1       OCT   01356000000000000
        00 0 00000
01465   00 0 00026            00    22
        00 0 00026            00    22
01466   20 4 34626   TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        65 5 12043
01467   65 2 56543   TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        20 3 12066
01470   71 6 54364   TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        20 2 02020
01471   43 6 13065   TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        51 2 00120
01472   75 0 01447            SLJ   PRINT
        50 0 00000
01473   75 0 00000   PRINT1   SLJ   **
        10 0 00012            ENA   10
01474   20 0 00017            STA   178
        50 0 00000
01475   75 0 01501   +        SLJ   *+4
        00 0 00000            00    0
01476   00 0 54255            00    FS5
        00 0 63715            00    FS6
01477   00 0 00047            00    39
        00 0 00035            00    29
01500   00 0 00022            00    18
        00 0 00010            00    8
01501   75 4 04745   +        RTJ   WAE
        00 0 00000            00    0
01502   75 4 02524   +        RTJ   MAC
        00 0 63715            00    FS6,0
01503   75 0 01473            SLJ   PRINT1
        77 7 63715            77    FS6,7
01504   10 0 02000            10    TAU
        00 0 00001            00    1
01505   00 0 00000            OCT   0
        00 0 00000
01506   20 0 00000            DEC   50-1B47
        00 0 00000
01507   00 0 00000            OCT   0
        00 0 00000
01510   03 1 46314            DEC   10-1B47
        63 1 46314
01511   00 0 00026            00    22
        00 0 00026            00    22
01512   20 4 36147   TITLE1   BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        43 4 16371
01513   41 4 52046   TITLE1   BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        66 2 02546
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01514   51 2 37163   TITLE1   BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        71 2 33020
01515   43 6 13065   TITLE1   BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        51 2 00120
01516   75 0 01473            SLJ   PRINT1
        50 0 00000
01517   75 0 00000   PRINT2   SLJ   **
        10 0 00012            ENA   10
01520   20 0 00017            STA   17B
        50 0 00000
01521   75 0 01525   +        SLJ   *+4
        00 0 00000            00    0
01522   00 0 05015            00    FS0
        00 0 63715            00    FS6
01522   00 0 05015            00    FS0
01523   00 0 00047            00    39
        00 0 00035            00    29
01524   00 0 00022            00    18
        00 0 00010            00    8
01525   75 4 04745   SKIP     RTJ   WAE
        00 0 00000            00    0
01526   75 4 02524   +        RTJ   MAC
        00 0 63715            00    FS6,0
01527   75 0 01517            SLJ   PRINT2
        77 7 63715            77    FS6,7
01530   10 0 02000            10    TAU
        00 0 00001            00    1
01531   00 0 00000            OCT   0
        00 0 00000
01532   20 0 00000            DEC   5D-1B47
        00 0 00000
01533   00 0 00000            OCT   0
        00 0 00000
01534   00 6 31463            DEC   25D-3B47
        14 6 31463
01535   00 0 00026            00    22
        00 0 00026            00    22
01536   20 2 56551   TITLE2   BCD   4, VERT GRAD OF VT        LAYER 1
        23 2 06751
01537   61 6 42046   TITLE2   BCD   4, VERT GRAD OF VT        LAYER 1
        66 2 02523
01540   20 2 02020   TITLE2   BCD   4, VERT GRAD OF VT        LAYER 1
        20 2 02020
01541   43 6 13065   TITLE2   BCD   4, VERT GRAD OF VT        LAYER 1
        51 2 00120
01542   75 0 01517            SLJ   PRINT2
        50 0 00000
01543   75 0 00000   PRINT3   SLJ   **
        10 0 00012            ENA   10
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01544   20 0 00017             STA   17B
        50 0 00000
01545   75 0 01551       +     SLJ   *+4
        00 0 00000             00    0
01546   00 0 54755             00    FS5
        00 0 63715             00    FS6
01547   00 0 00047             00    39
        00 0 00035             00    29
01550   00 0 00022             00    18
        00 0 00010             00    8
01551   75 4 04745       +     RTJ   WAL
        00 0 00000             00    0
01552   75 4 02524       +     RTJ   MAC
        00 0 63715             00    FS6,0
01553   75 0 01543             SLJ   PRINT3
        77 7 63715             77    FS6,7
01554   10 0 02000             10    TAU
        00 0 00001             00    1
01555      0 00000             OCT   0
        00 0 00000
01556   20 0 00000             DEC   50-1B47
        00 0 00000
01557   00 0 00000             OCT   0
        00 0 00000
01560   03 1 46314             DEC   10-1B47
        63 1 46314
01561   00 0 00026             00    22
        00 0 00026             00    22
01562   20 6 12565   TITLE3    BCD   4, AVERAGE DIVERGENCE     LAYER 1
        51 6 16765
01563   20 6 47125   TITLE3    BCD   4, AVERAGE DIVERGENCE     LAYER 1
        65 5 16765
01564   45 6 36520   TITLE3    BCD   4, AVERAGE DIVERGENCE     LAYER 1
        20 2 02020
01565   43 6 13065   TITLE3    BCD   4, AVERAGE DIVERGENCE     LAYER 1
        51 2 00120
01566   75 0 01543             SLJ   PRINT3
        50 0 00000
01567   75 0 00000   PRINT4    SLJ   **
        15 0 00012             ENA   10
01570   20 0 00017             STA   17B
        50 0 00000
01571   75 0 01575       +     SLJ   *+4
        00 0 00000             00    0
01572   00 0 55715             00    FS5
        00 0 63715             00    FS6
01573   00 0 00047             00    39
        00 0 00035             00    29
```

```
01574   00 0 00022                    00     18
        00 0 00010                    00     8

01575   75 4 04745     +              RTJ    WAE
        00 0 00000                    00     0

01576   75 4 02524     +              RTJ    MAC
        00 0 63715                    00     FS6,0

01577   75 0 01567                    SLJ    PRINT4
        77 7 63715                    77     FS6,7

01600   10 0 02000                    10     TAU
        00 0 00001                    00     1

01601   00 0 00000                    OCT    0
        00 0 00000

01602   20 0 00000                    DEC    5D-1B47
        00 0 00000

01603   00 0 00000                    OCT    0
        00 0 00000

01604   03 1 46314                    DEC    1D-1B47
        63 1 46314

01605   00 0 00026                    00     22
        00 0 00026                    00     22

01606   20 4 27145     TITLE4         BCD    4, KINETIC ENERGY         LAYER 1
        65 2 37163

01607   20 6 54565     TITLE4         BCD    4, KINETIC ENERGY         LAYER 1
        51 6 73020

01610   20 2 02020     TITLE4         BCD    4, KINETIC ENERGY         LAYER 1
        20 2 02020

01611   43 6 13065     TITLE4         BCD    4, KINETIC ENERGY         LAYER 1
        51 2 00120

01612   75 0 01567                    SLJ    PRINT4
        50 0 00000

01613   75 0 00000     PRINT5         SLJ    **
        10 0 00012                    ENA    10

01614   20 0 00017                    STA    17B
        50 0 00000

01615   75 0 01621     +              SLJ    *+4
        00 0 00000                    00     0

01616   00 0 44215                    00     FS4
        00 0 63715                    00     FS6

01617   00 0 00047                    00     39
        00 0 00035                    00     29

01620   00 0 00022                    00     18
        00 0 00010                    00     8

01621   75 4 04745     +              RTJ    WAE
        00 0 00000                    00     0

01622   75 4 02524     +              RTJ    MAC
        00 0 63715                    00     FS6,0

01623   75 0 01613                    SLJ    PRINT5
        77 7 63715                    77     FS6,7
```

```
01624   10 0 02000              10    TAU
        00 0 00001              00    1

01625   00 0 00000              OCT   0
        00 0 00000

01626   20 0 00000              DEC   5D-1B47
        00 0 00000

01627   00 0 00000              OCT   0
        00 0 00000

01630   03 1 46314              DEC   1D-1B47
        63 1 46314

01631   00 0 00026              00    22
        00 0 00026              00    22

01632   20 4 27145    TITLE5    BCD   4, KINT ENERGY DIFF       LAYER 1
        23 2 06545

01633   65 5 16730    TITLE5    BCD   4, KINT ENERGY DIFF       LAYER 1
        20 6 47166

01634   66 2 02020    TITLE5    BCD   4, KINT ENERGY DIFF       LAYER 1
        20   02020

01635   43 6 13065    TITLE5    BCD   4, KINT ENERGY DIFF       LAYER 1
        51 2 00120

01636   75 0 01613              SLJ   PRINT5
        50 0 00000

01637   75 0 00000    PRINT6    SLJ   **
        10 0 00012              ENA   10

01640   20 0 00017              STA   17B
        50 0 00000

01641   75 0 01645    +         SLJ   *+4
        00 0 00000              00    0

01642   00 0 63715              00    FS6
        00 0 14655              00    FS1

01643   00 0 00047              00    39
        00 0 00035              00    29

01644   00 0 00022              00    18
        00 0 00010              00    8

01645   75 4 04745    +         RTJ   WAE
        00 0 00000              00    0

01646   75 4 02524    +         RTJ   MAC
        00 0 14655              00    FS1,0

01647   75 0 01637              SLJ   PRINT6
        77 7 14655              77    FS1,7

01650   10 0 02000              10    TAU
        00 0 00001              00    1

01651   00 0 00000              OCT   0
        00 0 00000

01652   20 0 00000              DEC   5D-1B47
        00 0 00000

01653   00 0 00000              OCT   0
        00 0 00000
```

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01654   14 3 31463          DEC   25D-3847
        14 3 31463
01655   00 0 00026          00    22
        00 0 00026          00    22
01656   20 6 37045  TITLE6  BCD   4, CHNG IN KINETIC ENERGY LAYER 1
        67 2 07145
01657   25 4 27145  TITLE6  BCD   4, CHNG IN KINETIC ENERGY LAYER 1
        65 2 37163
01660   25 6 54565  TITLE6  BCD   4, CHNG IN KINETIC ENERGY LAYER 1
        51 6 73020
01661   43 6 13065  TITLE6  BCD   4, CHNG IN KINETIC ENERGY LAYER 1
        01 2 00120
01662   75 0 01637          SLJ   PRINT6
        50 0 00000
01663   75 0 00000  PRINT7  SLJ   **
        10 0 00012          ENA   10
01664   20 0 00017          STA   17B
        50 0 00000
01665   75 0 01671  +       SLJ   *+4
        00 0 00000          00    0
01666   00 0 05015          00    FS0
        00 0 63715          00    FS6
01667   00 0 00047          00    39
        00 0 00035          00    29
01670   00 0 00022          00    18
        00 0 00010          00    8
01671   75 4 04745  +       RTJ   WAE
        00 0 00000          00    0
01672   75 4 02524  +       RTJ   MAC
        00 0 63715          00    FS6,0
01673   75 0 01663          SLJ   PRINT7
        77 7 63715          77    FS6,7
01674   10 0 02000          10    TAU
        00 0 00001          00    1
01675   00 0 00000          OCT   0
        00 0 00000
01676   20 0 00000          DEC   5D-1847
        00 0 00000
01677   00 0 00000          OCT   0
        00 0 00000
01700   10 0 00000          DEC   25D-2847
        00 0 00000
01701   00 0 00026          00    22
        00 0 00026          00    22
01702   25 4 75146  TITLE7  BCD   4, PROG KAT FIELD       LAYER 1
        67 2 04261
01703   23 2 06671  TITLE7  BCD   4, PROG KAT FIELD       LAYER 1
        65 4 36420
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01704   20 2 02020   TITLE7   BCD   4, PROG KAT FIELD        LAYER 1
        26 2 02020
01705   43 6 13065   TITLE7   BCD   4, PROG KAT FIELD        LAYER 1
        51 2 00120
01706   75 0 01663            SLJ   PRINT7
        50 0 00000
01707   75 0 00000   PRINT8   SLJ   **
        10 0 00012            ENA   10
01710   20 0 00017            STA   17B
        50 0 00000
01711   75 0 01715   +        SLJ   *+4
        00 0 00000            00    0
01712   00 0 14655            00    FS1
        00 0 63715            00    FS6
01713   00 0 0[illegible]7    00    39
        00 0 00035            00    29
01714   00 0 00022            00    18
        00 0 00010            00    8
01715   75 4 04745   +        RTJ   WAF
        00 0 00000            00    0
01716   75 4 02524   +        RTJ   MAC
        00 0 63715            00    FS6,0
01717   75 0 01707            SLJ   PRINT8
        77 7 63715            77    FS6,7
01720   10 0 02000            10    TAU
        00 0 00001            00    1
01721   00 0 00000            OCT   0
        00 0 00000
01722   20 0 00000            DEC   5D-1B47
        00 0 00000
01723   00 0 00000            OCT   0
        00 0 00000
01724   03 1 46314            DEC   1D-1B47
        63 1 46314
01725   00 0 00026            00    22
        00 0 00026            00    22
01726   20 6 16425   TITLE8   BCD   4, ADVEC OF OMEGA BY TEMP LAYER 1
        65 6 32046
01727   66 2 04644   TITLE8   BCD   4, ADVEC OF OMEGA BY TEMP LAYER 1
        65 6 76120
01730   62 3 02023   TITLE8   BCD   4, ADVEC OF OMEGA BY TEMP LAYER 1
        65 4 44720
01731   43 6 13065   TITLE8   BCD   4, ADVEC OF OMEGA BY TEMP LAYER 1
        51 2 00120
01732   75 0 01707            SLJ   PRINT8
        50 0 00000
01733   20 0 00000   CONST1   DEC   5D-1B47
        00 0 00000
```

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01734   05 5 11512    CONST2   DEC   17637D-5B47
        62 5 77555
01735   64 2 02003    NAME1    OCT   6420200312122020
        12 1 22020
01736   64 2 02002    NAME1A   OCT   6420200212122020
        12 1 22020
01737   64 2 02001    NAME1B   OCT   6420200112122020
        12 1 22020
01740   64 2 02005    NAME2    OCT   6420200512122020
        12 1 22020
01741   64 2 02003    NAME2A   OCT   6420200312122020
        12 1 22020
01742   64 2 02002    NAME2B   OCT   6420200212122020
        12 1 22020
01743   23 2 02003    NAME3    OCT   2320200312122020
        12 1 22020
01744   23 2 02002    NAME3A   OCT   2320200212122020
        12 1 22020
01745   23 2 02001    NAME3B   OCT   2320200112122020
        12 1 22020
01746   23 2 02005    NAME4    OCT   2320200512122020
        12 1 22020
01747   23 2 02003    NAME4A   OCT   2320200312122020
        12 1 22020
01750   23 2 02002    NAME4B   OCT   2320200212122020
        12 1 22020
01751   46 4 46720    NAME5    OCT   4644672003121220
        03 1 21220
01752   46 4 46720    NAME5A   OCT   4644672002121220
        02 1 21220
01753   46 4 46720    NAME5B   OCT   4644672001121220
        01 1 21220
01754   46 4 46720    NAME6    OCT   4644672005121220
        05 1 21220
01755   46 4 46720    NAME6A   OCT   4644672003121220
        03 1 21220
01756   46 4 46720    NAME6B   OCT   4644672002121220
        02 1 21220
01757   17 7 77777    COUNT    OCT   1777777777777777
        77 7 77777
01760   17 7 77777    COUNT1   OCT   1777777777777777
        77 7 77777
01761   43 6 13065    LEVEL2   OCT   4361306551200220
        51 2 00220
01762   43 6 13065    LEVEL3   OCT   4361306551200320
        51 2 00320
01763   07 2 47764    A2       OCT   0724776415014743
        15 0 14743
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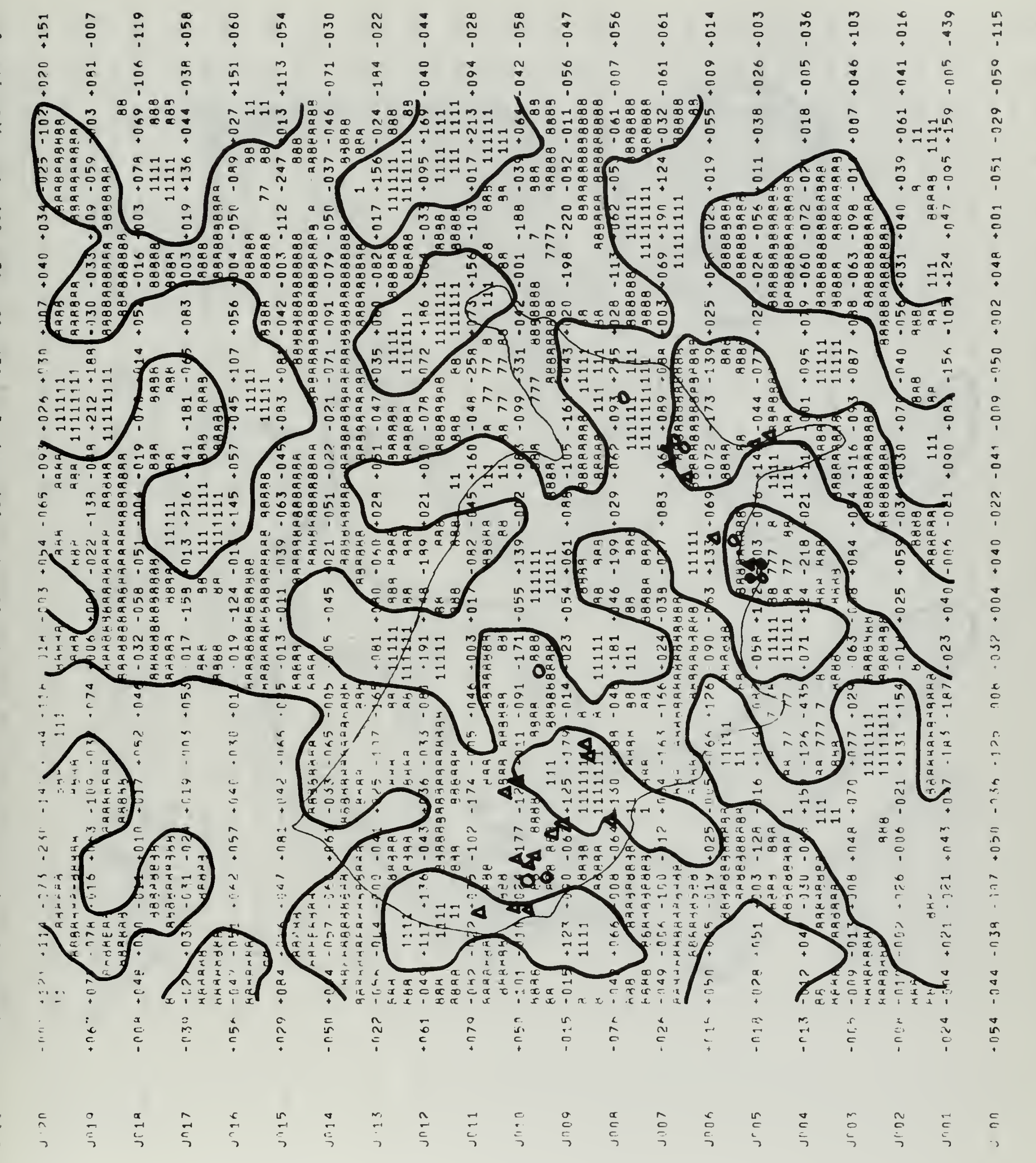
01764   11 3 33231      A3       OCT   1133323141120344
        41 1 20344
01765   01 0 30675      B2       OCT   0103067572026573
        72 0 26573
01766   01 0 30675      B3       OCT   0103067572026573
        72 0 26573
01767   02 7 34000      C2       OCT   0273400000000000
        00 0 00000
01770   02 7 34000      C3       OCT   0273400000000000
        00 0 00000
01771   77 0 12577      D2       OCT   7701257777777777
        77 7 77777
01772   77 3 02377      D3       OCT   7730237777777777
        77 7 77777
01773   00 0 00000      E2       OCT   2
        00 0 00002
01774   00 0 00000      E3       OCT   2
        00 0 00002
01775        01776      LOCAT1   BSS   1
01776        01777      LOCAT2   BSS   1
01777   00 0 00000      TAPUNIT  OCT   50001200
        50 0 01200
02000   00 0 00000      TAU      DEC   24
        00 0 00030
02001   12 1 21205      TIME     OCT   1212120512010605
        12 0 10605
02002   76 0 01027      HATERR   SLS   MHAT
        50 0 00000
02003   76 0 01342      JACERR   SLS   MOORE
        50 0 00000
02004   76 0 01006      LAPERR1  SLS   LAPLAC1
        50 0 00000
02005   76 0 01014      LAPERR2  SLS   LAPLAC2
        50 0 00000
02006   76 0 01274      LAPERR3  SLS   LAPKIN
        50 0 00000
02007   76 0 00705      READERR  SLS   READD1
        50 0 00000
02010   76 0 01137      SQERR    SLS   DTHM
        50 0 00000
02011   76 0 00774      VORTER1  SLS   VORTIS1
        50 0 00000
02012   76 0 01001      VORTER2  SLS   VORTIS2
        50 0 00000
02013   76 0 00761      WINDERR  SLS   REWIND
        50 0 00000
```

02014	02524	MAA	LIB	MAA
02524	04231	MAC	LIB	MAC
04231	04371	MAG	LIB	MAG
04371	04423	SAB	LIB	SAB
04423	04451	SAD	LIB	SAD
04451	04535	SAH	LIB	SAH
04535	04570	SAI	LIB	SAI
04570	04611	SAJ	LIB	SAJ
04611	04666	SAR	LIB	SAR
04666	04715	VAB	LIB	VAB
04715	04745	WAB	LIB	WAB
04745	05015	WAE	LIB	WAE
05015	14655	FS0	BSS	4000
14655	24515	FS1	BSS	4000
24515	34355	FS2	BSS	4000
34355	44215	FS3	PSS	4000
44215	54055	FS4	BSS	4000
54055	63715	FS5	BSS	4000
63715	73555	FS6	BSS	4000
73555	00000		END	

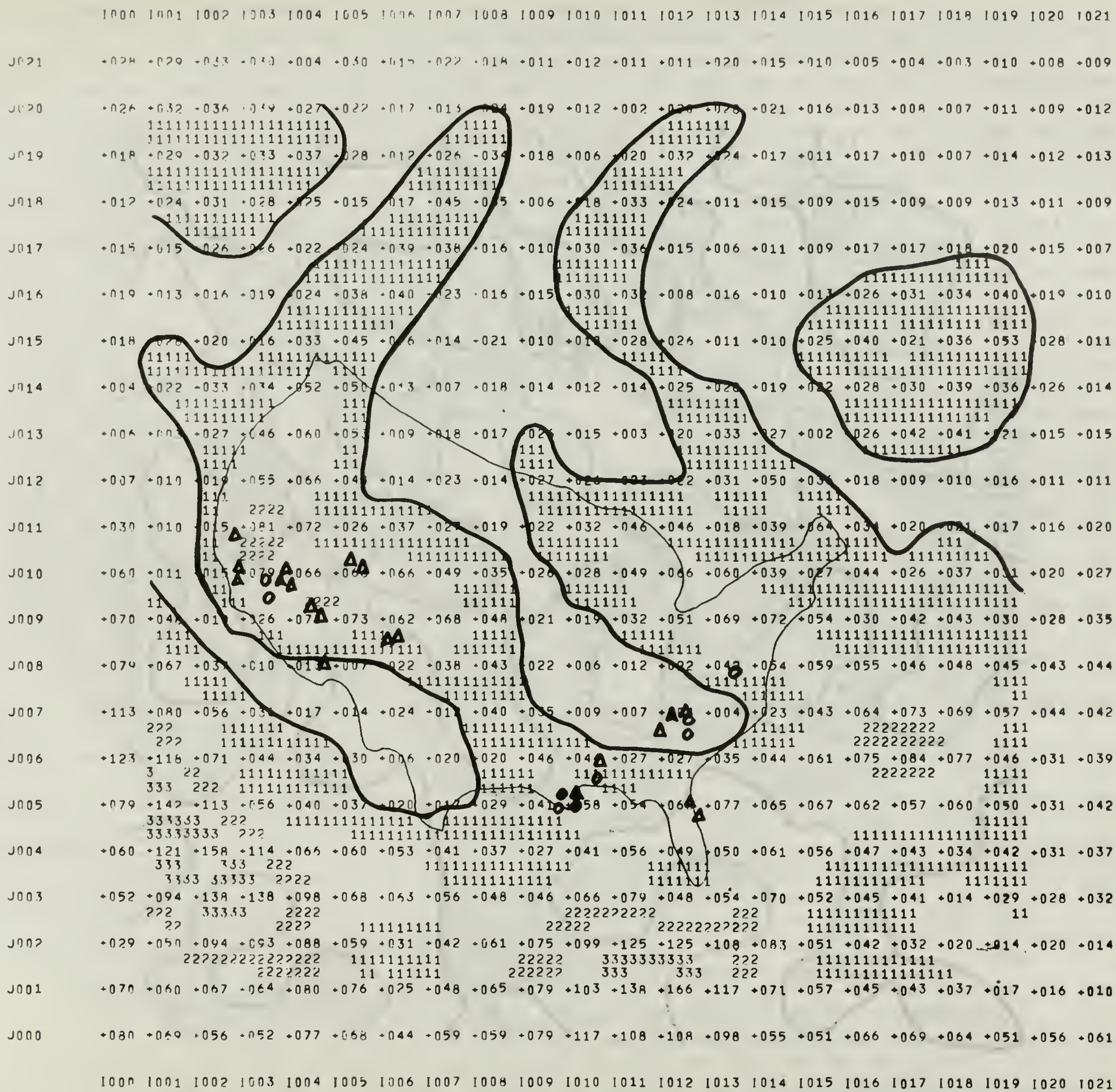
8. APPENDIX C

PRINTED FIELDS FROM THE RESEARCH PROGRAM FOR OOZ 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+50'	+434	+327	+168	+069	+109	+186	+208	+206	+197	+169	+132	+116	+163	+283	+413	+492	+532	+544	+509	+488	+525
J020	+589	+531	+418	+256	+136	+140	+213	+236	+203	+181	+159	+119	+144	+278	+432	+529	+584	+605	+615	+586	+593	+620
J019	+659	+608	+508	+390	+287	+238	+261	+259	+200	+154	+135	+135	+214	+385	+535	+594	+624	+650	+656	+659	+663	+656
J018	+702	+667	+601	+517	+433	+371	+338	+285	+194	+130	+137	+190	+264	+379	+513	+588	+612	+644	+676	+681	+670	+657
J017	+734	+708	+666	+606	+542	+477	+397	+303	+196	+128	+165	+249	+299	+357	+453	+518	+526	+551	+605	+637	+650	+646
J016	+763	+747	+712	+566	+610	+530	+422	+313	+211	+144	+172	+243	+291	+335	+379	+392	+376	+374	+429	+522	+589	+597
J015	+781	+777	+740	+585	+618	+517	+406	+316	+236	+177	+167	+191	+220	+249	+258	+240	+218	+214	+271	+397	+498	+536
J014	+787	+774	+727	+660	+575	+465	+376	+315	+256	+209	+176	+163	+162	+151	+140	+125	+118	+157	+245	+349	+440	+510
J013	+792	+764	+715	+678	+531	+427	+365	+322	+279	+237	+188	+159	+138	+100	+087	+097	+114	+186	+297	+381	+447	+529
J012	+798	+761	+715	+633	+512	+411	+362	+337	+320	+280	+215	+170	+127	+060	+047	+105	+154	+215	+333	+442	+507	+570
J011	+797	+752	+705	+625	+505	+420	+384	+368	+361	+339	+283	+222	+155	+044	+993	+067	+133	+192	+327	+471	+558	+613
J010	+792	+754	+715	+641	+542	+488	+463	+433	+416	+409	+382	+321	+234	+120	+051	+070	+108	+187	+332	+474	+578	+652
J009	+791	+767	+741	+686	+617	+581	+551	+515	+505	+492	+467	+430	+357	+283	+243	+215	+215	+290	+410	+524	+622	+699
J008	+795	+775	+756	+719	+673	+643	+608	+579	+581	+566	+536	+526	+496	+458	+439	+416	+417	+473	+548	+622	+696	+757
J007	+803	+785	+767	+739	+708	+679	+645	+626	+627	+621	+615	+613	+600	+584	+574	+570	+586	+629	+677	+721	+770	+812
J006	+812	+800	+784	+758	+733	+704	+676	+668	+668	+663	+667	+673	+667	+657	+657	+668	+684	+713	+755	+797	+830	+856
J005	+818	+809	+798	+776	+750	+727	+703	+692	+700	+696	+688	+706	+714	+709	+717	+732	+744	+765	+802	+841	+868	+883
J004	+824	+815	+807	+791	+772	+755	+727	+708	+719	+727	+725	+741	+752	+754	+768	+781	+786	+803	+832	+863	+885	+894
J003	+827	+820	+813	+804	+793	+778	+756	+739	+742	+757	+767	+775	+784	+792	+804	+813	+818	+831	+853	+875	+889	+894
J002	+831	+825	+821	+815	+806	+792	+777	+767	+769	+782	+792	+798	+809	+817	+822	+830	+842	+855	+869	+879	+880	+878
J001	+834	+831	+827	+822	+814	+801	+787	+782	+789	+800	+807	+812	+820	+828	+832	+842	+855	+865	+873	+874	+865	+858
J000	+835	+834	+831	+827	+820	+811	+802	+800	+805	+813	+817	+818	+822	+832	+840	+848	+857	+864	+868	+865	+856	+852



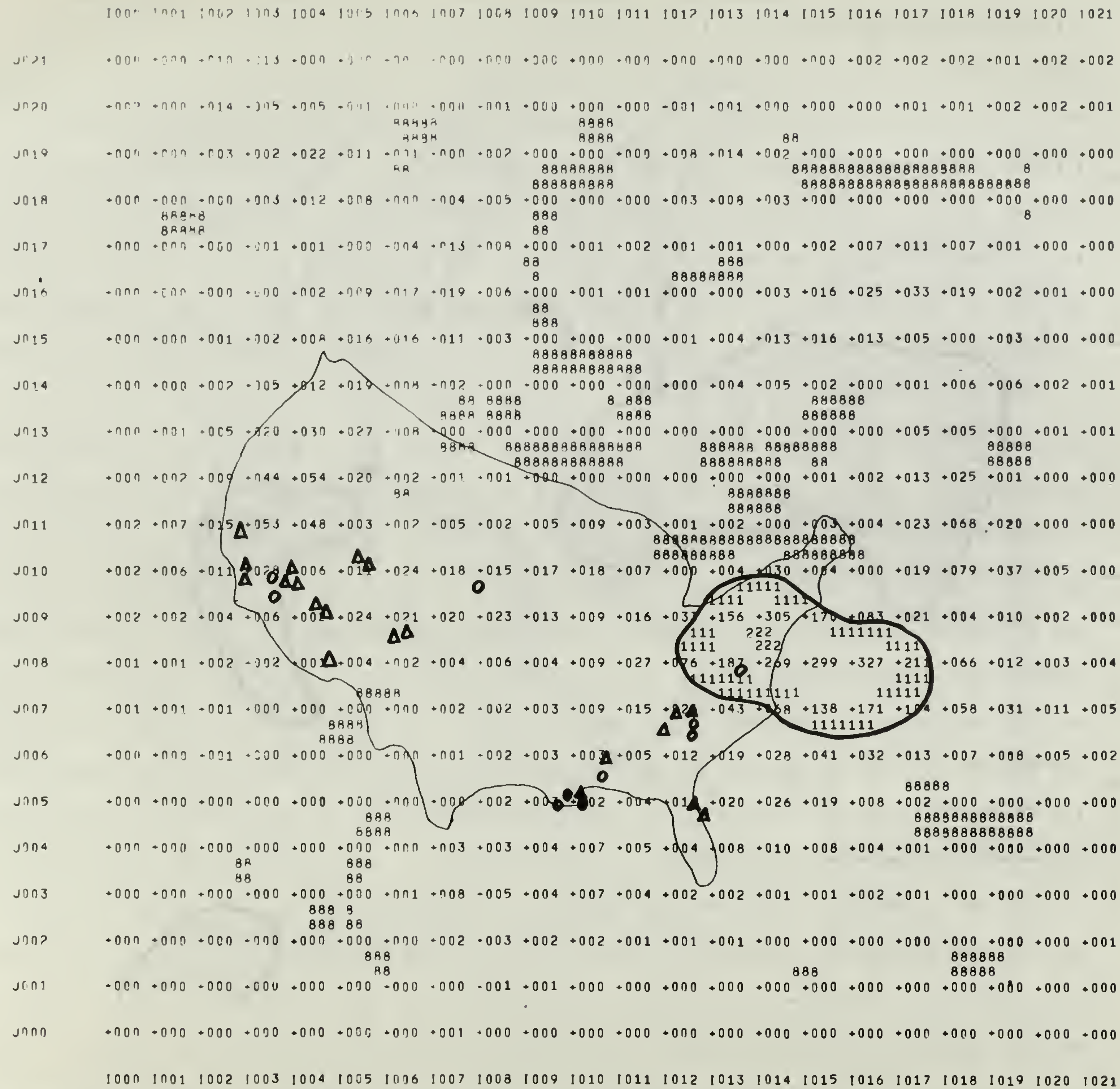
LAPLACIAN OF VORTICITY LAYER 1 ... DEG. 24 HOURS 00Z 23 FEB 65



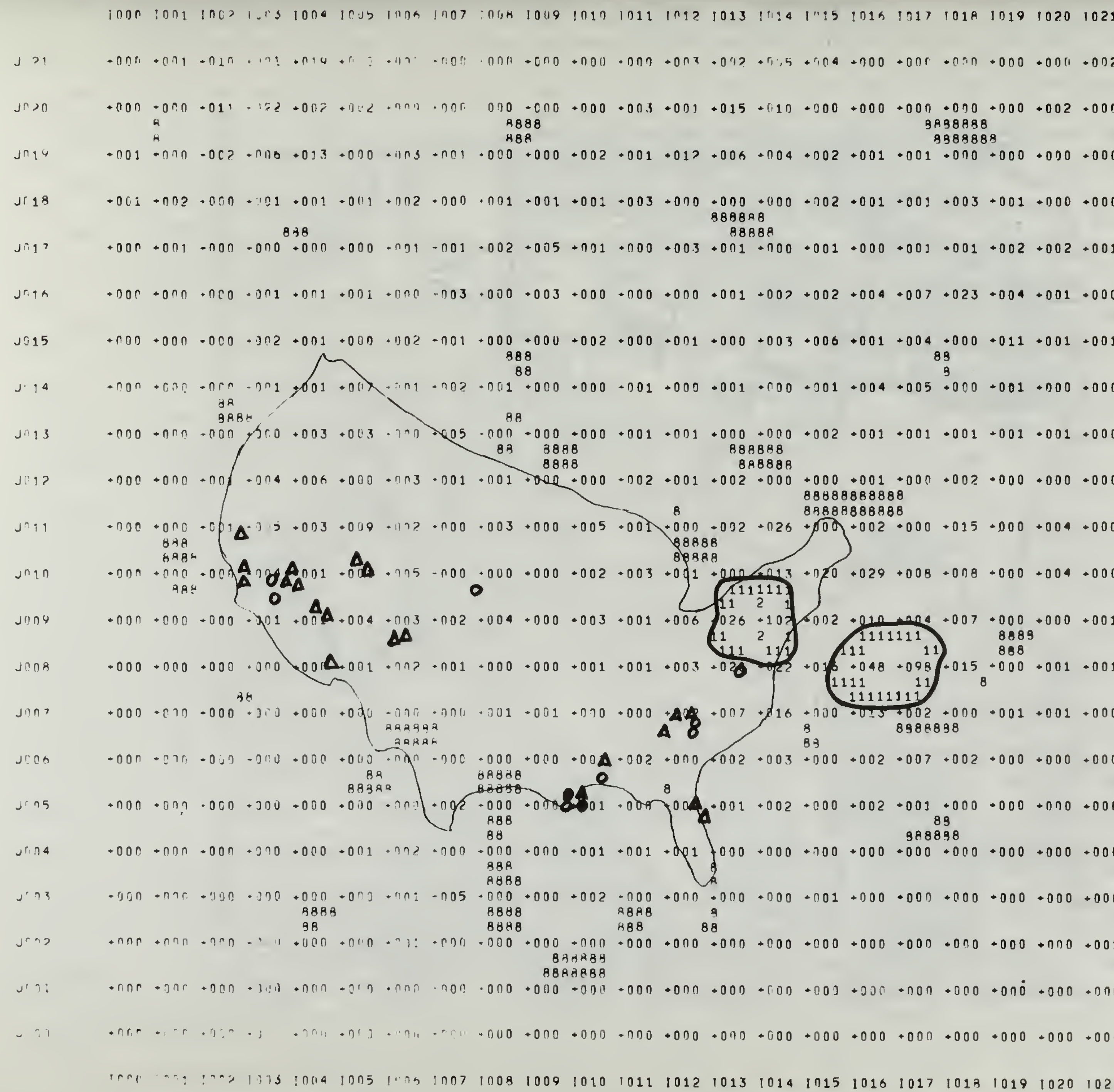
VERT GRAD OF VT - LAYER 1 PROG. 24 HOURS 00Z 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+088	[illegible]	+127	+088	+007	+015	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	+001	[illegible]	+031	[illegible]	+ 65	+041	+025	+020	+021	+026	+036
J020	+066	[illegible]	[illegible]	[illegible]	+062	[illegible]	+011	[illegible]	[illegible]	+008	+003	+001	-035	+089	[illegible]	+146	+022	+013	+013	+020	+027	+014
J019	+03-	[illegible]	+119	+140	[illegible]	+054	+013	+011	+023	+010	+000	-020	+072	+080	+037	+011	+003	+002	+005	+009	+005	+002
J018	+014	+035	+077	[illegible]	+096	+063	+028	+034	+036	+005	+008	+040	+044	+046	+033	+009	+007	+009	+003	+000	+001	+001
J017	+008	+017	-038	+162	+065	+052	+045	-057	+044	+002	+023	+029	+013	+019	+029	+030	+043	+059	+056	+023	+004	+005
J016	+005	+011	+016	+026	+040	+052	+065	+069	-042	+004	+016	+025	+017	+018	-031	+063	+080	+094	+110	+077	+026	+014
J015	+002	+005	-012	+022	+048	+072	+078	+056	-029	+010	+001	+017	+029	+039	+057	+068	+057	+043	+064	+083	+046	+012
J014	+002	-008	+024	+045	+087	+113	+073	+027	+013	+013	+002	+002	+011	+030	+035	+020	+011	+018	+041	+040	+031	+015
J013	+008	+015	+036	+074	+106	+096	+048	+007	+010	+019	+010	+002	+003	-011	+011	+003	+010	+044	+060	+041	+029	+026
J012	+015	+026	+048	+105	+119	+071	+031	+017	-016	+033	+032	+017	+016	+006	+010	+014	+021	+059	+087	+058	+043	+036
J011	+024	+042	+062	+116	+117	+060	+045	+037	-027	+050	+078	+061	+061	+039	+001	+025	+033	+077	+132	+079	+039	+037
J010	+027	+044	+066	+112	+115	+102	+095	+074	+063	+069	+099	+117	+131	+130	+089	+057	+049	+104	+162	+109	+060	+055
J009	+023	+033	+053	[illegible]	+097	+102	+096	+082	-078	+063	+071	+124	+186	+248	+283	+207	+171	+222	+217	+144	+101	+082
J008	+024	+028	+040	+053	+054	+053	+047	+041	+040	+043	+056	+094	+163	+232	+267	+274	+308	+331	+255	+169	+126	+090
J007	+024	+031	-039	+045	+039	[illegible]	+038	+029	-021	+029	+048	+063	+088	+108	+131	+188	+238	+226	+181	+143	+109	+073
J006	+016	+027	-030	[illegible]	+035	[illegible]	+036	+027	-023	+029	+027	-036	+058	+070	[illegible]	+116	+118	+104	[illegible]	+088	+067	+040
J005	+009	+017	+031	+041	+038	+037	+033	+017	+024	+029	+025	+036	+054	+071	+085	+078	+061	+057	+056	+044	+028	+014
J004	+005	+009	+019	+031	+038	+046	+052	+034	+030	+031	+044	+044	+037	+048	+055	+046	+037	+037	+036	+023	+010	+003
J003	+002	+005	+010	+017	+025	+032	+047	-052	+037	+037	+046	-034	+027	+029	+022	+019	+025	+027	+021	+010	+003	+002
J002	+001	[illegible]	+005	+009	+014	+017	+018	+023	+028	+029	+026	+021	+020	+016	+008	+010	+017	+014	+006	+001	+005	+012
J001	+000	+001	-002	+005	+009	+014	+011	+011	+018	+017	+013	+010	+008	+006	+006	+009	+008	+003	+000	+002	+007	+006
J000	+001	-001	[illegible]	[illegible]	+007	[illegible]	[illegible]	+012	+012	+008	+005	+004	+002	+002	+005	+006	+002	[illegible]	+000	+002	+001	+000
	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021

KINETIC ENERGY   LAYER 1   PROG.   24 HOURS   00Z 23 FEB 65

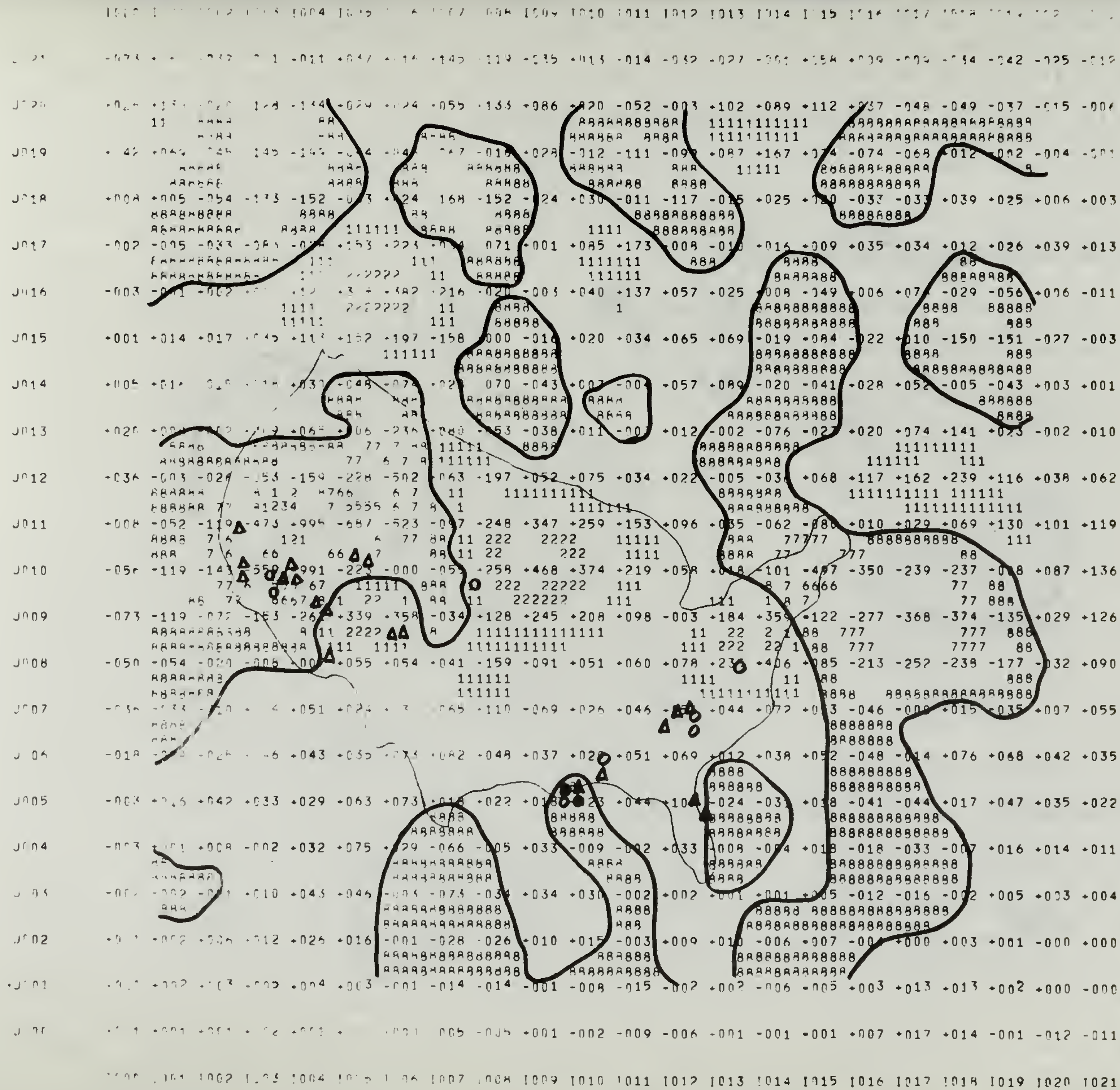


KINT ENERGY DIFF _ LAYER 1 PROG. 24 HOURS 00Z 23 FEB 65

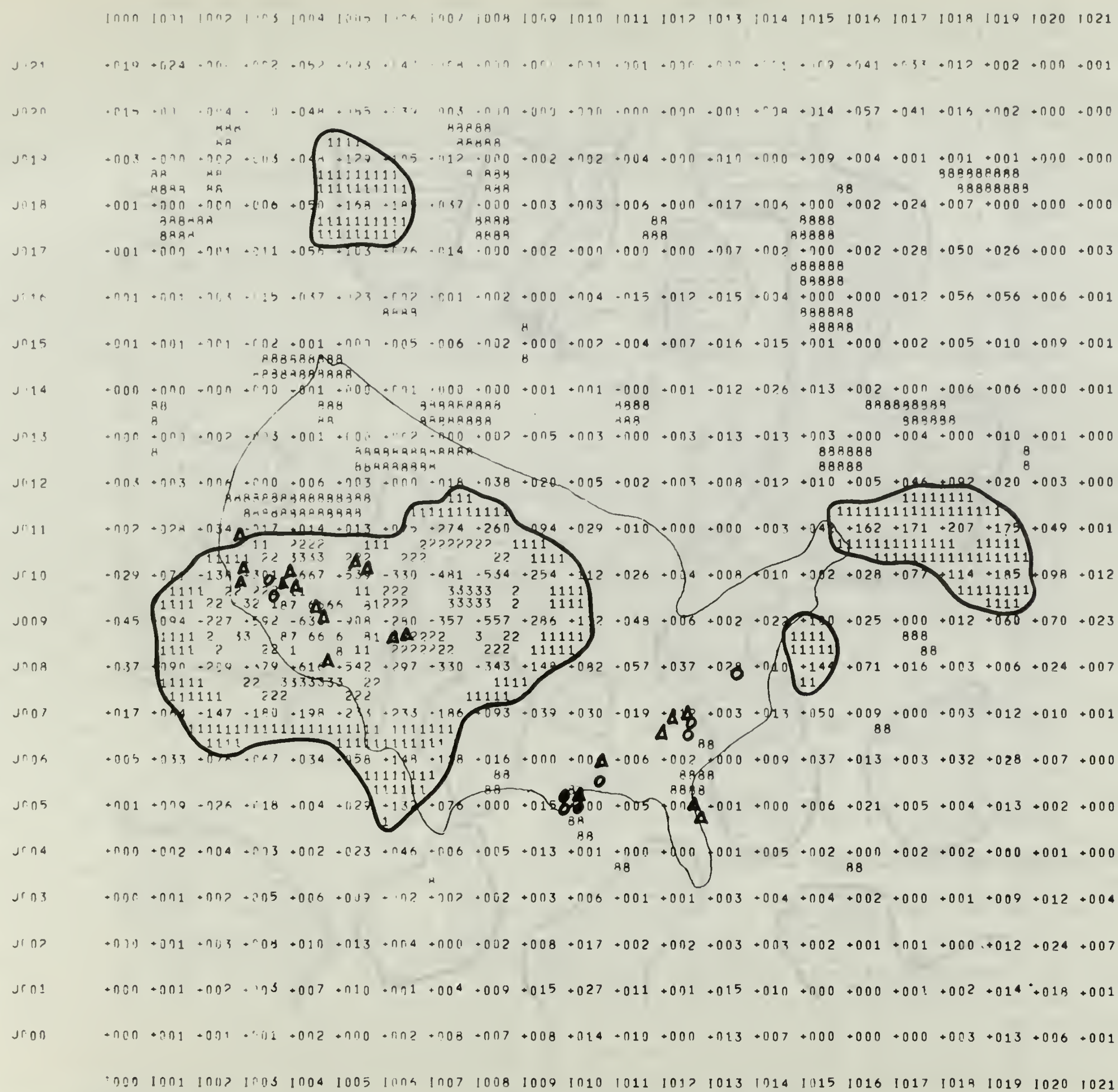


CHNG IN KINETIC ENERGY LAYER 1   PROG.   24 HOURS   00Z 23 FEB 65

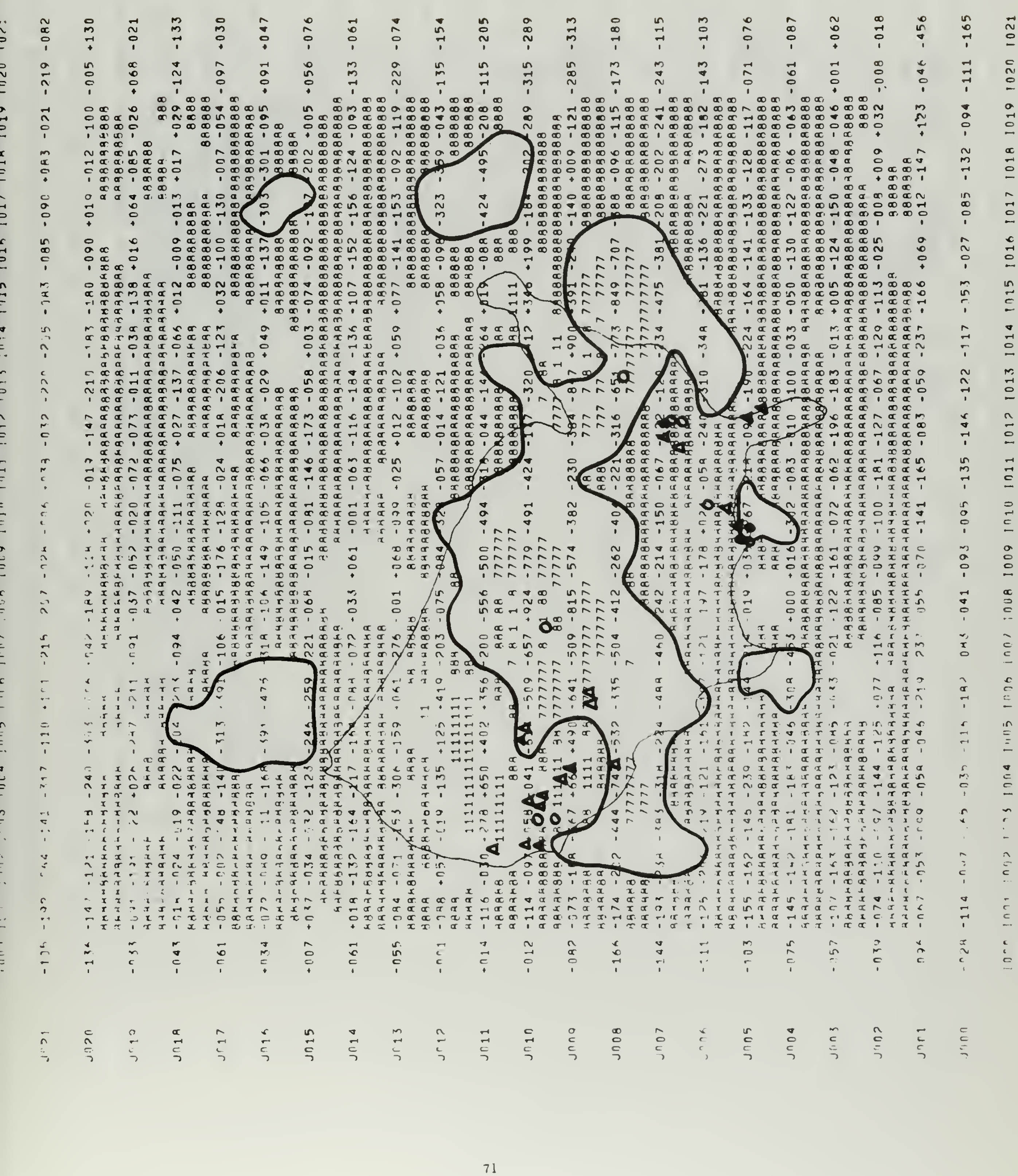
PROG KAT FIELD _LAYER 1 PROG. 24 HOURS 00Z 23 FEB 65



A... OF OMEGA BY TEMP LAYER 1 PROG. 24 HOURS 00Z 23 FEB 65

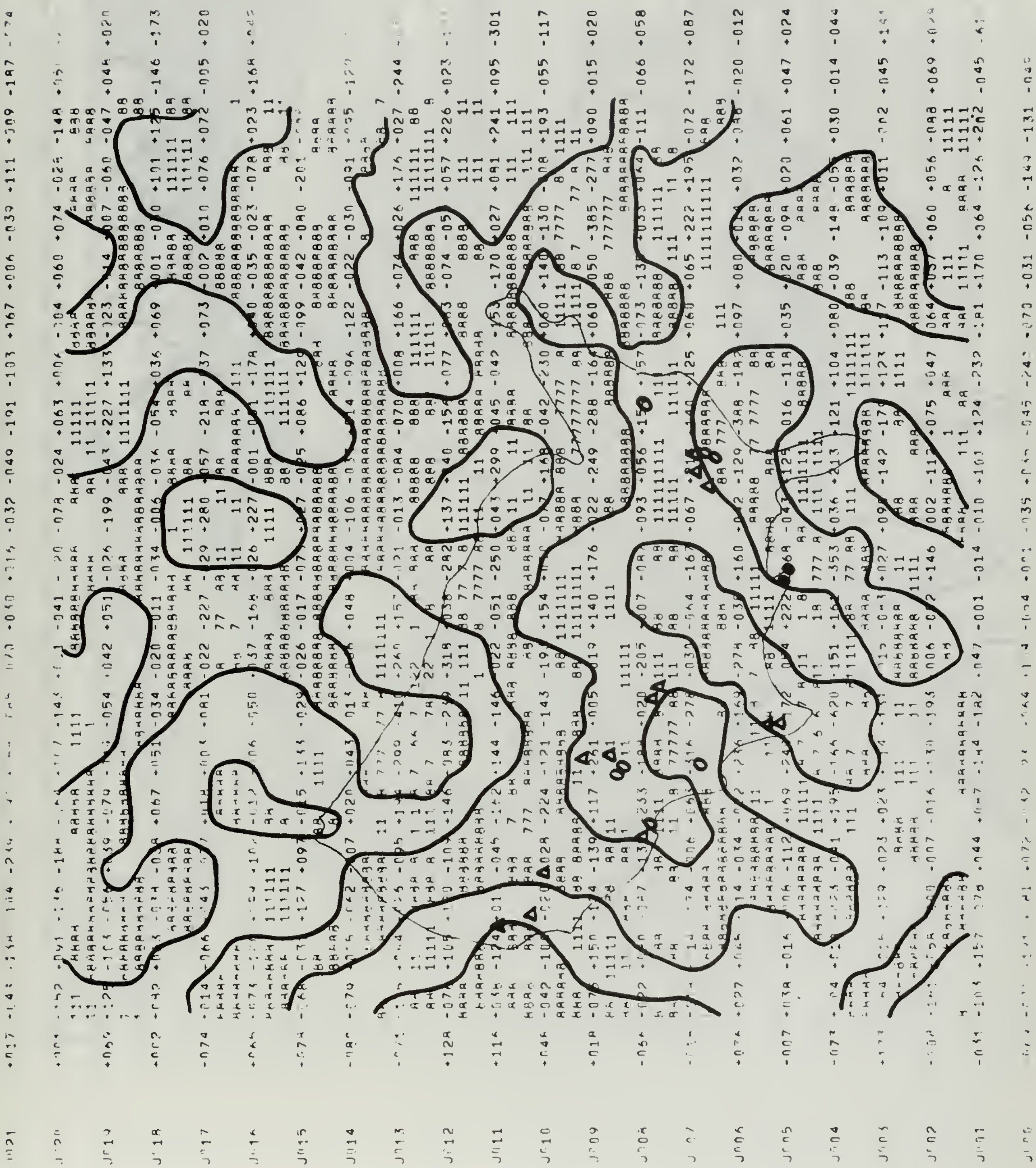


AVERAGE DIVERGENCE LAYER 1 PROG. 24 HOURS 00Z 23 FEB 65

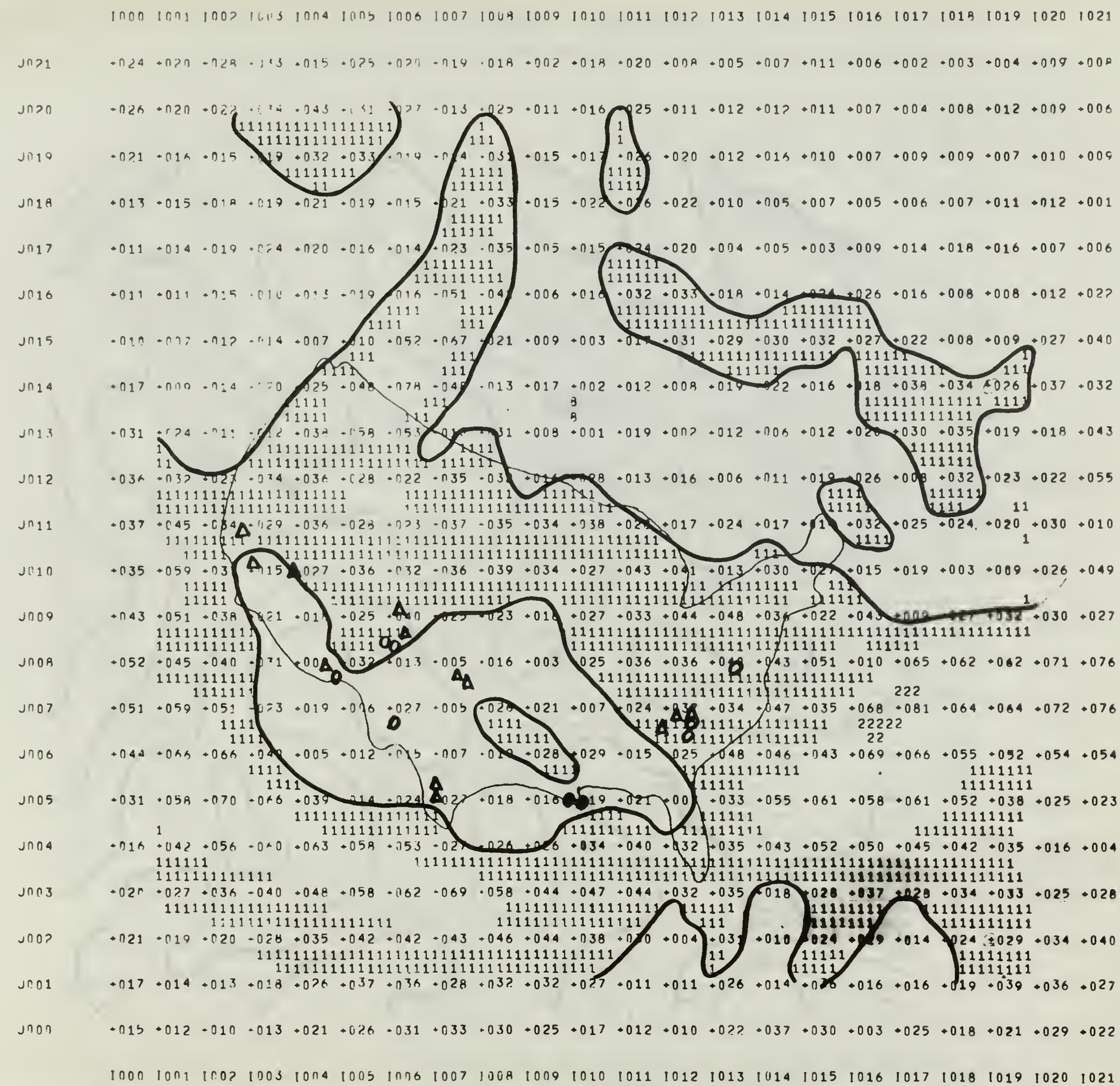

24 HOURS
00Z 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+938	[illegible]	[illegible]	[illegible]	+854	[illegible]	+868	+866	+857	+842	+845	+844	+847	+855	+868	+883	+893	+898	+899	+896	+897	+902
J020	[illegible]	[illegible]	[illegible]	[illegible]	+862	+865	+872	+871	+860	+848	+842	+842	+853	+870	+886	+898	+907	+910	+909	+906	+909	+913
J019	+928	+921	+907	+892	+881	+876	+877	+873	+859	+845	+841	+846	+863	+886	+902	+910	+914	+916	+916	+916	+917	+916
J018	+932	+928	+919	+907	+898	+892	+886	+875	+858	+845	+846	+857	+872	+887	+903	+912	+914	+915	+919	+920	+918	+917
J017	+935	+933	+928	+920	+912	+902	+892	+877	+857	+845	+852	+868	+878	+886	+897	+904	+904	+905	+910	+916	+917	+917
J016	+939	+937	+934	+930	+921	+900	+895	+877	+859	+848	+854	+868	+877	+884	+890	+890	+887	+886	+892	+904	+913	+912
J015	+942	+940	+936	+932	+922	+908	+892	+875	+860	+852	+853	+859	+866	+873	+875	+872	+868	+869	+876	+891	+903	+906
J014	+942	+941	+935	+928	+916	+900	+882	+866	+862	+858	+853	+853	+856	+858	+859	+858	+859	+863	+874	+886	+894	+901
J013	+945	+941	+935	+925	+910	+893	+874	+864	+867	+863	+855	+853	+852	+849	+851	+855	+858	+867	+880	+890	+895	+902
J012	+949	+943	+935	+924	+906	+891	+877	+871	+874	+869	+860	+858	+854	+847	+847	+853	+859	+869	+887	+900	+904	+909
J011	+952	+944	+935	+923	+906	+893	+885	+881	+881	+879	+873	+868	+861	+849	+844	+851	+860	+871	+890	+906	+913	+918
J010	+955	+946	+938	+926	+913	+903	+897	+893	+892	+893	+889	+881	+871	+857	+850	+856	+864	+873	+891	+908	+917	+924
J009	+956	+950	+942	+933	+923	+918	+914	+909	+907	+906	+903	+896	+885	+875	+871	+872	+875	+883	+898	+914	+923	+931
J008	+958	+953	+946	+938	+931	+929	+924	+920	+918	+915	+912	+910	+905	+900	+897	+895	+896	+905	+916	+925	+934	+942
J007	+961	+956	+950	+943	+938	+935	+929	+924	+923	+922	+921	+922	+919	+916	+915	+915	+919	+926	+934	+940	+946	+952
J006	+964	+960	+954	+948	+943	+940	+936	+931	+928	+928	+929	+930	+928	+926	+926	+929	+934	+940	+946	+951	+956	+960
J005	+965	+963	+958	+953	+948	+945	+941	+935	+934	+936	+935	+937	+938	+938	+938	+941	+944	+948	+954	+958	+962	+965
J004	+966	+964	+961	+958	+954	+950	+945	+939	+940	+942	+942	+944	+947	+948	+949	+950	+951	+953	+958	+962	+965	+967
J003	+967	+966	+964	+961	+958	+955	+952	+948	+947	+948	+949	+951	+952	+953	+955	+956	+956	+958	+961	+964	+966	+967
J002	+967	+966	+965	+963	+961	+958	+956	+954	+953	+954	+956	+957	+957	+958	+958	+959	+960	+961	+963	+964	+965	+965
J001	+966	+966	+965	+964	+962	+960	+957	+956	+957	+958	+959	+960	+961	+961	+960	+961	+963	+963	+963	+963	+963	+962
J000	+966	+965	+965	+964	+963	+961	+959	+959	+960	+961	+962	+962	+963	+963	+962	+963	+964	+964	+963	+963	+962	+962

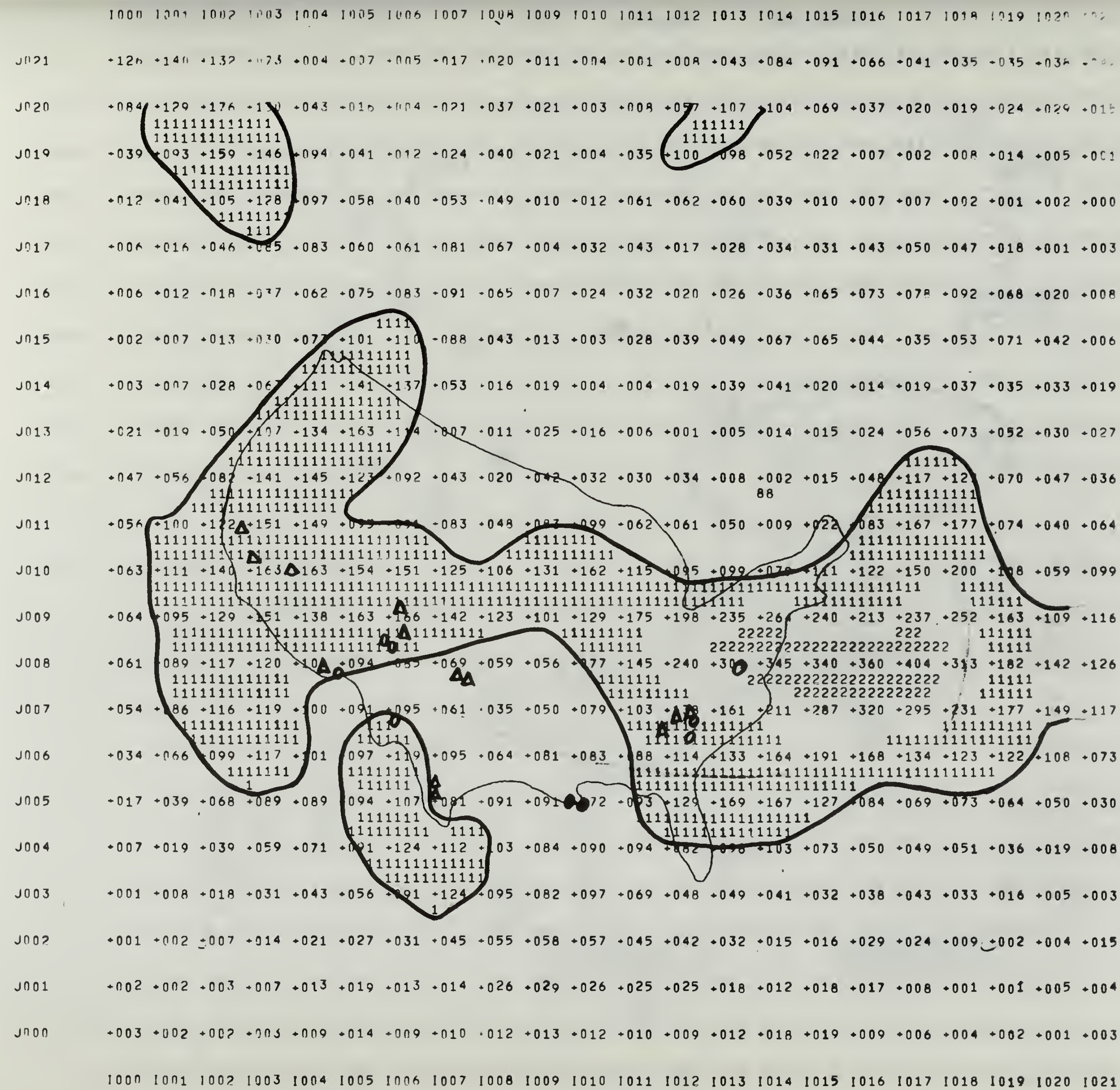
LOWER LEVEL Z FIELD LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65



LAPLACIAN OF VORTICITY LAYER 2 24 HOURS 00Z 23 FEB 65



VERT GRAD OF VT – LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65



KINETIC ENERGY _LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+002	+001	+012	+012	+000	+000	+000	-001	+002	+000	+000	+000	+000	+000	+000	+002	+005	+005	+005	+005	+004	+003
J020	+002	+000	+031	+008	+003	+000	+000	-001	+005	+002	+000	+000	+004	+000	+002	+001	+001	+002	+001	+002	+002	+001
J019	+000	+004	+013	+000	+015	+006	+000	+002	+006	+002	+000	+000	+017	+018	+001	+000	+000	+000	+000	+001	+000	+000
J018	+000	+001	+001	+002	+011	+003	+001	+010	+009	+000	+000	+000	+005	+015	+006	+000	+000	+000	+000	+000	+000	+000
J017	+000	+000	+000	+001	+001	+001	+010	+025	+018	+000	+003	+003	+001	+003	+001	+002	+007	+007	+004	+001	+000	+000
J016	+000	+000	+000	+000	+006	+019	+027	+033	+016	+000	+002	+002	+000	+000	+003	+017	+021	+020	+011	+001	+000	+000
J015	+000	+000	+000	+003	+019	+034	+033	+023	+007	+000	+000	+000	+002	+005	+018	+016	+008	+002	+000	+002	+000	+000
J014	+000	+000	+003	+011	+023	+045	+025	+004	+000	+000	+000	+000	+001	+005	+006	+001	+000	+001	+004	+005	+003	+001
J013	+000	+001	+010	+041	+053	+088	+047	+000	-000	+000	+000	+000	+000	+000	+000	+000	+002	+010	+004	+001	+000	+001
J012	+000	+006	+027	+079	+083	+060	+010	+005	+001	+000	+001	+003	+001	+000	+000	+000	+009	+052	+041	+000	+006	+000
J011	+002	+027	+053	+081	+065	+011	+004	+017	+006	+012	+030	+014	+002	+000	+000	+000	+015	[illegible]	[illegible]	+007	+003	+005
J010	+007	+029	+037	+043	+014	+010	+044	+045	+043	+061	+072	+024	+001	+002	+024	+020	+002	+035	+127	+029	+000	+008
J009	+007	+014	+017	+018	+002	+058	+058	+050	+056	+036	+036	+037	+041	+154	+279	+184	+107	+029	+018	+025	+000	+006
J008	+005	+008	+015	+006	[illegible]	+015	+003	+006	+010	+009	+019	+065	+174	+345	+476	+437	+379	+321	[illegible]	+010	+002	+007
J007	+002	+004	+007	+000	+006	+002	+000	+003	+004	+010	+025	+042	[illegible]	+099	+174	+278	+273	+184	[illegible]	+063	+019	+007
J006	+001	+001	+001	+001	+006	+007	+004	+003	+014	+024	+026	+031	+046	+071	+076	+080	+059	+024	+017	+025	+016	+004
J005	+000	+001	+000	+000	+004	+003	+000	+003	+033	+031	+019	+031	+067	+113	+093	+042	+016	+003	+000	+001	+002	+001
J004	+000	+000	+000	+000	+002	+000	+000	+029	+042	+027	+029	+022	+023	+036	+038	+020	+009	+002	+000	+000	+000	+000
J003	+000	+000	+000	+000	+000	+000	+005	+043	+035	+026	+033	+016	+008	+007	+005	+004	+005	+003	+000	+000	+000	+000
J002	+000	+000	+000	+000	+000	+000	+000	+005	+012	+013	+012	+008	+007	+004	+001	+001	+002	+001	+000	+000	+000	+001
J001	+000	+000	+000	+000	+000	+001	+000	+001	+002	+003	+002	+002	+002	+001	+001	+000	+000	+000	+000	+000	+000	+000
J000	+000	+000	-000	+000	+000	+000	+000	+000	-000	+000	+000	+000	+000	+000	+001	+001	+000	+000	+000	+000	+000	+000
	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021

KINT ENERGY DIFF   LAYER 2   PROG.   24 HOURS   00Z 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+002	+006	+007	+000	+012	+000	+000	+000	-000	+000	+000	+000	+005	+001	+005	+008	+002	+000	+000	+000	+000	-002
J020	+001	+001	+024	+007	+005	+001	+001	-000	-002	+000	+001	+004	+000	+016	+011	+000	+000	+000	+000	+000	+001	-000
J019	+003	+000	+013	+005	+002	+000	+004	+001	-001	-000	+003	+001	+022	+005	+003	+002	+002	+001	+000	+000	+001	-001
J018	+002	+004	+002	+006	+001	+000	+001	+000	+001	+002	+004	+009	+000	+000	+000	+003	+002	+001	+003	+001	+000	+000
J017	+000	+002	+002	+002	+001	+001	+000	+003	+005	+010	+002	+001	+007	+001	+000	+001	+000	+001	+001	+002	+001	+001
J016	+000	+000	+001	+002	+000	+000	+000	+002	+003	+006	+000	+000	+001	+001	+002	+003	+004	+004	+014	+005	+002	+000
J015	+000	+000	+001	+005	+000	+000	+001	+003	+000	+000	+003	+001	+002	+001	+006	+004	+000	+003	+001	+007	+002	+002
J014	+001	+001	+001	+000	+001	+003	+016	+001	+004	+000	+001	+002	+000	+002	+001	+003	+003	+004	+001	+003	+000	+000
J013	+000	+003	+001	+001	+000	+019	+003	+037	+001	+000	+000	+001	+004	+002	+000	+000	+001	+000	+000	+000	+001	+000
J012	+000	+001	+002	+006	+001	+000	+000	+001	+004	+000	+004	+000	+001	+004	+001	+001	+002	+005	+005	+000	+000	+001
J011	+001	+003	+000	+001	+002	+019	+003	+001	+010	+000	+003	+004	+000	+001	+014	+017	+001	+020	+020	+010	+007	+000
J010	+000	+002	+001	+002	+002	+002	+004	+000	+000	+005	+031	+001	+009	+004	+028	+000	+005	+016	+013	+004	+015	+005
J009	+000	+000	+000	+003	+001	+010	+015	+007	+007	+001	+000	+013	+002	+005	+025	+001	+011	+005	+009	+000	+002	+002
J008	+000	+000	+000	+000	+00[illegible]	+004	+007	+005	+002	+004	+010	+000	+028	+0[illegible]	+066	+016	+027	+167	+0[illegible]4	+005	+000	+001
J007	+000	+000	+002	+001	+000	+001	+001	+002	+009	+002	+000	+002	+0[illegible]	+022	+013	+003	+029	+009	+000	+001	+003	+001
J006	+000	+000	+001	+003	+000	+000	+007	+003	+002	+001	+000	+002	+001	+006	+002	+000	+003	+015	+004	+000	+001	+000
J005	+000	+000	+000	+001	+000	+000	+000	+007	+001	+001	+004	+000	+004	+022	+011	+000	+006	+004	+000	+001	+000	+001
J004	+000	+000	+000	+003	+000	+000	+009	+000	+001	+001	+000	+002	+002	+000	+001	+000	+002	+000	+000	+000	+001	+000
J003	+000	+000	+000	+009	+000	+001	+001	+024	+000	+000	+008	+000	+003	+000	+001	+002	+000	+001	+000	+000	+000	+000
J002	+000	+000	+000	+000	+000	+000	+003	+002	+000	+000	+000	+000	+000	+000	+002	+001	+000	+000	+000	+001	+000	+001
J001	+000	+000	+000	+000	+000	+000	+000	+001	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000
J000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+000	+001	+000	+000	+000	+000	+000

CHNG IN KINETIC ENERGY LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65

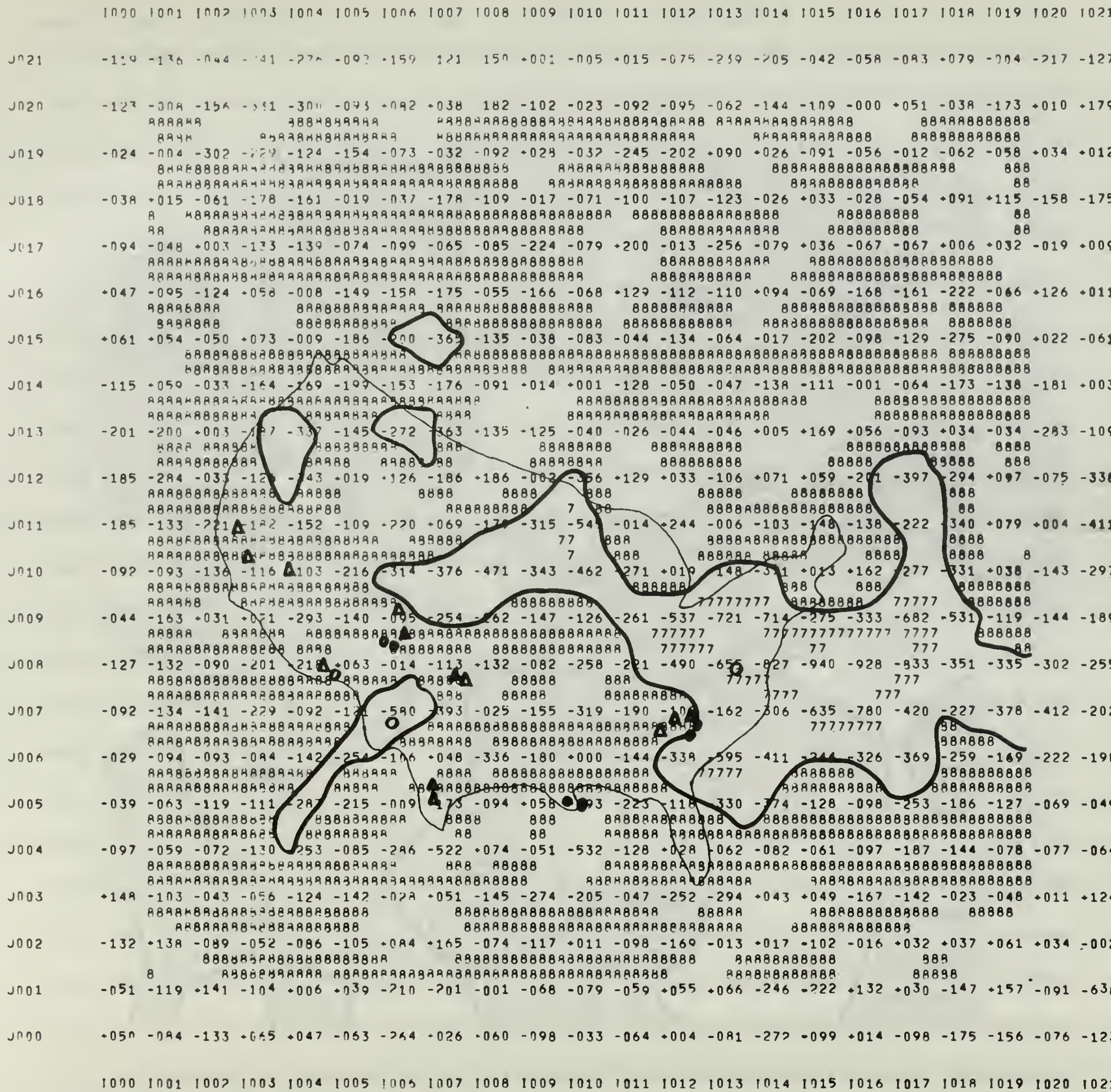
	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010
J021	-138	-124	-042	-272	-270	+059	+133	-122	-109	-016	-007
J020	-111	+002	-161	-316	-282	-113	-174	-109	-068	-076	-039
J019	+005	+012	-303	-226	-103	-159	-079	-012	-035	+013	-050
J018	-025	+021	-062	-194	-167	-014	-006	117	-112	-038	-071
J017	-091	-046	-001	-156	-142	-061	-082	-052	-148	-246	-081
J016	+048	-097	-135	+049	+021	-125	-132	-127	-088	-187	-068
J015	+067	+054	-057	+074	-002	-160	-063	-152	-096	-040	-081
J014	-101	+062	-040	-161	-167	-21[illegible]	-21[illegible]	-119	-069	+012	-003
J013	-124	-152	+012	-184	-320	-134	-517	-464	+218	+123	-038
J012	+044	-170	-029	-1[illegible]9	-3[illegible]5	-065	-207	-123	-261	-02[illegible]	-346
J011	+020	-136	-333	-24[illegible]	-295	-314	+023	+009	-120	-1[illegible]0	-42[illegible]
J010	-057	-2[illegible]3	-315	-202	-234	-425	-351	-349	-[illegible]81	-077	-242
J009	-096	-236	-034	-067	-298	-139	-018	-220	-227	-016	-016
J008	-184	-163	-092	-245	-25[illegible]	+088	+080	-065	+118	-065	-217
J007	-126	-167	-189	-316	-131	-036	-439	-349	-043	-148	-276
J006	-043	-106	-122	-146	-146	-138	+091	+062	-376	-173	+022
J005	-041	-060	-123	-148	-245	-042	+109	-289	-197	+083	-184
J004	-095	-058	-077	-142	-177	+045	-352	-788	-022	+023	-506
J003	+151	-099	-039	-042	-067	-091	-046	-129	-203	-235	-157
J002	-130	+140	-086	-042	-063	-086	+054	+098	-119	-117	+039
J001	-050	-119	+142	-103	+005	+030	-233	-226	-013	-064	-069
J000	+050	-084	-133	+065	+042	-073	-272	+021	+061	-093	-028

	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	+010	-071	-240	-200	-045	-072	-087	+068	-034	-239	-129
J020	-115	-096	-071	-123	-085	+014	+047	-055	-186	+008	+182
J019	-262	-202	+094	+061	-057	-029	-005	-077	-070	+032	+009
J018	-102	-125	-139	-013	+049	-012	-044	+089	+112	-160	-175
J017	+210	+012	-253	-078	+036	-061	-063	+005	+036	-015	+011
J016	+161	-055	-046	+123	-069	-159	-141	-202	-059	+134	+011
J015	-020	-099	+003	+008	-215	-120	-142	-263	-097	+022	-061
J014	-124	-060	-050	-167	-162	-057	-093	-166	-163	-202	+002
J013	-039	-091	-089	-012	+138	+026	-071	+064	-045	-294	-100
J012	+091	-013	-174	+063	+048	-159	-2[illegible]1	-148	+132	-053	-286
J011	-064	+219	-030	-082	-205	-300	-282	-252	+131	+014	-381
J010	-260	+023	-161	-391	-098	-003	-350	-351	+043	-154	-277
J009	-237	-535	-729	-768	[illegible]	-325	-664	-584	-130	-126	-131
J008	-153	-422	-598	-772	-917	-912	-925	-453	-369	-281	-152
J007	-103	-036	-176	-319	-547	-624	-348	-217	-377	-414	-115
J006	-093	-315	-646	-470	-218	-2[illegible]	-253	-168	-113	-200	-144
J005	-187	-082	-352	-443	-195	-144	-236	-106	-043	-030	-030
J004	-122	+076	-047	-082	-065	-149	-245	-148	-041	-049	-057
J003	-039	-232	-271	+058	+052	-194	-183	-056	-052	+015	+110
J002	-086	-165	+009	+020	-105	-023	+021	+021	+057	+031	-029
J001	-048	+063	+078	-259	-235	+136	+040	-146	+162	-087	-650
J000	-057	+016	-079	-303	-121	+020	-087	-171	-154	-080	-126

PROG KAT FIELD - LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65

	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021
J021	-019	+012	+002	-019	+006	-033	-026	-001	+041	+015	-002	-005	+004	-001	+006	-003	-014	-004	-011	-031	-022	-003
J020	+012	+010	-005	+015	+010	-019	-009	+071	+114	+026	-016	-024	-001	-009	+020	+024	+015	-003	-017	-013	-002	+003
J019	+029	+016	-001	+003	+02	-004	-006	+044	+057	-015	-018	-016	-000	+004	+035	+034	+026	+006	-014	-012	-002	-003
J018	+013	+007	-002	-016	-006	+005	+032	+061	-003	-021	+000	-002	-018	-017	+013	+016	+016	+010	-002	-003	-002	-000
J017	-003	+002	-004	-022	-003	+013	+017	+014	-062	-022	-002	+009	+025	+003	+001	+000	+006	+004	+001	+004	+004	+002
J016	+001	-001	-011	-008	-030	+024	+026	+04	-033	-020	+000	+032	+057	+064	+029	+000	+009	+020	+020	+007	+009	+000
J015	+005	+000	-007	+002	-007	+026	+137	+213	+039	-001	+001	+024	+035	+068	+025	-014	-022	-013	+012	-007	-000	+000
J014	+014	+003	-007	+003	+008	-017	-060	+057	+022	-003	-004	+004	-010	-004	-028	-051	-056	-029	+007	-025	-021	-001
J013	+077	+048	-009	-000	-017	+011	-245	-10	+083	-002	+002	-013	-047	-043	-016	-031	-030	+023	+030	-011	-010	+009
J012	+229	+113	+005	-013	-031	-084	-333	-13	+074	+018	+009	-039	-046	-068	-008	-011	+041	+156	+146	+035	+021	+052
J011	+206	-003	-112	-066	-143	-205	-197	-060	+058	+135	+125	-050	-026	-023	+020	-057	-162	-000	+088	+051	+011	+030
J010	+035	-151	-179	-086	+131	-210	-037	+027	+090	+266	+220	+011	+004	-014	-020	-111	-165	-073	-020	+005	-011	+021
J009	-052	-073	-065	-089	-004	+001	+077	+033	-035	+131	+110	+024	+002	-008	-054	-111	+008	+017	-053	-011	+018	+058
J008	-058	-031	-002	-043	-041	+025	+094	+048	-014	+017	+041	+068	+069	+056	+035	+023	+016	-092	-102	-034	+021	+103
J007	-035	-034	-049	-087	-040	+085	+141	+043	-018	+007	+043	+086	+072	-014	-014	+087	+155	+072	+009	+002	-002	+087
J006	-015	-012	-030	-062	-004	+116	+197	+014	-040	+007	+022	+052	+023	-051	-059	+026	+106	+116	+090	+056	+021	+046
J005	-002	+003	-004	-037	+042	+173	+118	+015	-103	+025	+009	+036	+036	-022	-070	-067	-046	+017	+081	+084	+039	+020
J004	+001	+001	-006	-012	+076	+130	-066	-266	-094	+073	+026	+006	+048	+015	-000	-004	-053	-058	-004	+037	+027	+007
J003	+003	+004	+003	-014	+056	+010	-074	-181	-058	+039	+047	+007	+020	+022	+015	+003	-027	-040	-033	-003	+003	-014
J002	+002	+002	+004	+009	+023	+019	-030	-068	-045	+000	+028	+012	+005	+021	+003	-003	-007	-011	-016	-004	-003	-027
J001	+001	+000	+000	-000	-001	-009	-023	-024	-012	+005	+010	+011	+008	+012	-013	-013	+004	+009	+001	+005	+005	-013
J000	+000	-000	-000	-000	-004	-010	-008	-005	+001	+006	+005	+007	+013	+002	-031	+022	+006	+011	+004	+002	-003	-003
	I000	I001	I002	I003	I004	I005	I006	I007	I008	I009	I010	I011	I012	I013	I014	I015	I016	I017	I018	I019	I020	I021

ADVEC OF OMEGA BY TEMP LAYER 2 -ROG. 24 HOURS 00Z 23 FEB 65



PROG KAT FIELD LAYER 2 PROG. 24 HOURS 00Z 23 FEB 65

9. APPENDIX D

THE CLEAR AIR TURBULENCE FORECAST COMPUTER PROGRAM

```
                                        KAT FORECAST
                                        BEGIN STEERING PROGRAM
                                        COMPUTES 500 TO 300 MB LAYER
         00600               ORG  600B
00600  20 0 01461            STA  TIME      PUT DATE TIME IN A REGISTER
       50 0 00000
00601  75 4 00674   START    RTJ  READD2    READS PACKED LOWER LEVEL D FIELD INTO
                                            FS4
       50 0 00000
00602  75 4 00702   +        RTJ  UNPCKD2   UNPACKS LOWER LEVEL D FIELD INTO FS1
       50 0 00000
00603  75 4 00722   +        RTJ  READT2    READS LOWER LEVEL TEMPERATURE FIELD
                                            INTO FS4
       50 0 00000
00604  75 4 00730   +        RTJ  UNPCKT2   UNPACKS LOWER LEVEL TEMPERATURE FIELD
                                            INTO FS3
       50 0 00000
00605  75 4 00661   +        RTJ  READD1    READS PACKED UPPER LEVEL D FIELD INTO
                                            FS4
       50 0 00000
00606  75 4 00667   +        RTJ  UNPCKD1   UNPACKS UPPER LEVEL D FIELD INTO FS0
       50 0 00000
00607  75 4 00707   +        RTJ  READT1    READS UPPER LEVEL TEMPERATURE FIELD IN
                                            TO FS4
       50 0 00000
00610  75 4 00715   +        RTJ  UNPCKT1   UNPACKS UPPER LEVEL TEMPERATURE FIELD
                                            INTO FS2
       50 0 00000
00611  75 4 00735   +        RTJ  REWIND    REWINDS TU 3 CH 5/6
       50 0 00000
00612  75 4 00741   +        RTJ  REWIND1   REWINDS TU 2 CH 5/6
       50 0 00000
00613  75 4 01274   +        RTJ  PRINT     PRINTS LOWER HEIGHT FIELD
       50 0 00000
00614  75 4 00745   +        RTJ  SINF      GENERATES SINE FIELD STOWS IN FS4
       50 0 00000
00615  75 4 00750   +        RTJ  VORTIS1   COMPUTES VORTICITY FIELD FROM UPPER
                                            LEVEL D FIELD STOWS IN FS5
       50 0 00000
00616  75 4 00755   +        RTJ  VORTIS2   COMPUTES VORTICITY FIELD FROM LOWER
                                            LEVEL D FIELD STOWS IN FS6
       50 0 00000
00617  75 4 00762   +        RTJ  LAPLAC1   COMPUTES LAPLACIAN OF UPPER LEVEL VORT
                                            ICITY FIELD STOWS IN FS0
       50 0 00000
00620  75 4 00770   +        RTJ  LAPLAC2   COMPUTES LAPLACIAN OF LOWER LEVEL VORT
                                            ICITY FIELD STOWS IN FS1
       50 0 00000
```

```
00621   75 4 00776    +   RTJ   HORIZ     COMPUTES AVERAGE LAPLACIAN BETWEEN
                                          UPPER AND LOWER LEVELS STOWS IN FS5
        50 0 00000
00622   75 4 01320    +   RTJ   PRINT1    PRINTS LAPLACIAN OF VORTICITY
        50 0 00000
00623   75 4 01003    +   RTJ   MHAT      STOWS SCALED MAP FACTOR IN FS6
        50 0 00000
00624   75 4 01011    +   RTJ   UTHM1     COMPUTES U COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS0
        50 0 00000
00625   75 4 01027    +   RTJ   UTHM2     COMPUTES U COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS1
        50 0 00000
00626   75 4 01045    +   RTJ   DUTHM     COMPUTES U COMPONENT DIFFERANCE
                                          BETWEEN UPPER AND LOWER LEVELS STOWS
                                          IN FS0
        50 0 00000
00627   75 4 01052    +   RTJ   VTHM1     COMPUTES V COMPONENT OF THERMAL WIND
                                          AT LOWER LEVEL STOWS IN FS1
        50 0 00000
00630   75 4 01070    +   RTJ   VTHM2     COMPUTES V COMPONENT OF THERMAL WIND
                                          AT UPPER LEVEL STOWS IN FS2
        50 0 00000
00631   75 4 01106    +   RTJ   DVTHM     COMPUTES V COMPONENT DIFFERANCE
                                          BETWEEM UPPER AND LOWER LEVELS STOWS
                                          IN FS1
        50 0 00000
00632   75 4 01113    +   RTJ   DTHM      COMPUTES VERTICAL GRADIENT OF
                                          THERMAL WIND STOWS IN FS0
        50 0 00000
00633   75 4 01343    +   RTJ   PRINT2    PRINTS VERTICAL GRADIENT OF VT
        50 0 00000
00634   75 4 01123    +   RTJ   KAT1      HORIZ MINUS DTHM STOWS IN FS5
        50 0 00000
00635   75 4 00674    +   RTJ   READD2    SEE ABOVE
        50 0 00000
00636   75 4 00702    +   RTJ   UNPCKD2   SEE ABOVE
        50 0 00000
00637   75 4 00661    +   RTJ   READD1    SEE ABOVE
        50 0 00000
00640   75 4 00667    +   RTJ   UNPCKD1   SEE ABOVE
        50 0 00000
00641   75 4 00735    +   RTJ   REWIND    REWINDS TU 3 CH 5/6
        50 0 00000
00642   75 4 00741    +   RTJ   REWIND1   REWINDS TU 2 CH 5/6
        50 0 00000
00643   75 4 00745    +   RTJ   SINF      SEE ABOVE
        50 0 00000
```

```
00644   75 4 01003   +        RTJ   MHAT       SEE ABOVE
        50 0 00000
00645   75 4 01130   +        RTJ   UGEOS1     COMPUTES U COMPONENT OF GEOSTROPHIC
                                               WIND AT UPPER LEVEL STOWS IN FS2
        50 0 00000
00646   75 4 01146   +        RTJ   UGEOS2     COMPUTES U COMPONENT OF GEOSTROPHIC
                                               WIND AT LOWER LEVEL STOWS IN FS3
        50 0 00000
00647   75 4 01164   +        RTJ   UGEOS      COMPUTES AVERAGE U COMPONENT STOWS
                                               IN FS2
        50 0 00000
00650   75 4 01173   +        RTJ   VGEOS1     COMPUTES V COMPONENT OF GEOSTROPHIC
                                               WIND AT UPPER LEVEL STOWS IN FS3
        50 0 00000
00651   75 4 01211   +        RTJ   VGEOS2     COMPUTES V COMPONENT OF GEOSTROPHIC
                                               WIND AT LOWER LEVEL STOWS IN FS[illegible]
        50 0 00000
00652   75 4 01227   +        RTJ   VGEOS      COMPUTES AVERAGE V COMPONENT STOWS
                                               IN FS0
        50 0 00000
00653   75 4 01236   +        RTJ   KINETIC    COMPUTES V SQUARE STOWS IN FS0
                                               COMPUTES V SQ DIFF STOWS IN FS4
        50 0 00000
00654   75 4 01366   +        RTJ   PRINT3     PRINTS KINETIC ENERGY FIELD
        50 0 00000
00655   75 4 01246   +        RTJ   KAT2       STOWS PREVIOUS TERMS IN FS0
        50 0 00000
00656   75 4 01411   +        RTJ   PRINT4     PRINTS PROG KAT FIELD
        50 0 00000
00657   75 4 01253   +        RTJ   LAYER2     COMPUTES 300 TO 200 MB LAYER
        50 0 00000
00660   76 0 00000   +        SLS              END OF STEERING PROGRAM USES OFF LINE
                                               PRINTING
        50 0 00000
00661   75 0 00000   READD1   SLJ   **
        50 0 00000
00662   12 0 01461   +        LDA   TIME
        16 0 01436            LDO   NAME1
00663   75 4 03707   +        RTJ   MAG
        00 0 00000            00    0,0
00664   50 0 01472   HIGHD    ENI   MAA
        50 0 01300            ENI   1300B
00665   50 0 43641            ENI   FS4
        50 0 01465            ENI   READERR
00666   75 0 00661            SLJ   READD1
        50 0 00000
00667   75 0 00000   UNPCKD1  SLJ   **
        50 6 00000            ENI   0,6
```

```
00670   75 0 00672   +         SLJ   *+2
        00 0 43641             00    FS4

00671   00 0 04441             00    FS0
        00 0 02453             00    2453B

00672   75 4 04341   +         RTJ   WAB
        50 0 00007             ENI   7

00673   75 0 00667             SLJ   UNPCKD1
        50 0 00000

00674   75 0 00000   READD2    SLJ   **
        50 0 00000

00675   12 0 01461   +         LDA   TIME
        16 0 01440             LDQ   NAME2

00676   75 4 03707   +         RTJ   MAG
        00 0 00000             00    0,0

00677   50 0 01472             ENI   MAA
        50 0 01300             ENI   1300B

00700   50 0 43641             ENI   FS4
        50 0 01465             ENI   READERR

00701   75 0 00674             SLJ   READD2
        50 0 00000

00702   75 0 00000   UNPCKD2   SLJ   **
        50 6 00000             ENI   0,6

00703   75 0 00705   +         SLJ   *+2
        00 0 43641             00    FS4

00704   00 0 14301             00    FS1
        00 0 02453             00    2453B

00705   75 4 04341   +         RTJ   WAB
        50 0 00007             ENI   7

00706   75 0 00702             SLJ   UNPCKD2
        50 0 00000

00707   75 0 00000   READT1    SLJ   **
        50 0 00000

00710   12 0 01461   +         LDA   TIME
        16 0 01442             LDQ   NAME3

00711   75 4 03707   +         RTJ   MAG
        00 0 00000             00    0,0

00712   50 0 01472   HIGHT     ENI   MAA
        50 0 01300             ENI   1300B

00713   50 0 43641             ENI   FS4
        50 0 01465             ENI   READERR

00714   75 0 00707             SLJ   READT1
        50 0 00000

00715   75 0 00000   UNPCKT1   SLJ   **
        50 6 00000             ENI   0,6

00716   75 0 00720   +         SLJ   *+2
        00 0 43641             00    FS4

00717   00 0 24141             00    FS2
        00 0 02453             00    2453B
```

```
00720    75 4 04341    +        RTJ   WAB
         50 0 00007             ENI   7
00721    75 0 00715             SLJ   UNPCKT1
         50 0 00000
00722    75 0 00000   READT2    SLJ   **
         50 0 00000
00723    12 0 01461    +        LDA   TIME
         16 0 01444             LDQ   NAME4
00724    75 4 03707    +        RTJ   MAG
         00 0 00000             00    0,0
00725    50 0 01472             ENI   MAA
         50 0 01300             ENI   1300B
00726    50 0 43641             ENI   FS4
         50 0 01465             ENI   READERR
00727    75 0 00722             SLJ   READT2
         50 0 00000
00730    75 0 00000   UNPCKT2   SLJ   **
         50 6 00000             ENI   0,6
00731    75 0 00733    +        SLJ   *+2
         00 0 43641             00    FS4
00732    00 0 34001             00    FS3
         00 0 02453             00    2453B
00733    75 4 04341    +        RTJ   WAB
         50 0 00007             ENI   7
00734    75 0 00730             SLJ   UNPCKT2
         50 0 00000
00735    75 0 00000   REWIND    SLJ   **
         50 0 00000
00736    75 4 01472    +        RTJ   MAA
         00 0 11306             00    11306B
00737    75 0 00735    +        SLJ   REWIND
         50 0 00000
00740    75 0 01471    +        SLJ   WINDERR
         50 0 00000
00741    75 0 00000   REWIND1   SLJ   **
         50 0 00000
00742    75 4 01472    +        RTJ   MAA
         00 0 11206             00    11206B
00743    75 0 00741    +        SLJ   REWIND1
         50 0 00000
00744    75 0 01471    +        SLJ   WINDERR
         50 0 00000
00745    75 0 00000   SINF      SLJ   **
         50 0 00000
00746    75 4 04161    +        RTJ   SAI
         50 0 43641             ENI   FS4
00747    75 0 00745    +        SLJ   SINF
         50 0 00000
```

```
00750     75 0 00000     VORTIS1   SLJ   **
          50 0 00000
00751     75 4 04235     +         RTJ   SAR
          50 0 43641               ENI   FS4
00752     50 0 04441               ENI   FS0
          50 0 53501               ENI   FS5
00753     50 0 01467               ENI   VORTER1
          50 0 04075               ENI   SAH
00754     75 0 00750               SLJ   VORTIS1
          50 0 00000
00755     75 0 00000     VORTIS2   SLJ   **
          50 0 00000
00756     75 4 04235     +         RTJ   SAR
          50 0 43641               ENI   FS4
00757     50 0 14301               ENI   FS1
          50 0 63341               ENI   FS6
00760     50 0 01470               ENI   VORTER2
          50 0 04075               ENI   SAH
00761     75 0 00755               SLJ   VORTIS2
          50 0 00000
00762     75 0 00000     LAPLAC1   SLJ   **
          50 0 00000
00763     75 4 04047     +         RTJ   SAD
          00 0 04441               00    FS0
00764     00 0 53501               00    FS5
          00 0 01463               00    LAPERR1
00765     75 4 04075     +         RTJ   SAH
          50 0 04073               ENI   SAD+24B
00766     50 0 04061               ENI   SAD+12B
          50 0 04061               ENI   SAD+12B
00767     75 0 00762               SLJ   LAPLAC1
          50 0 00000
00770     75 0 00000     LAPLAC2   SLJ   **
          50 0 00000
00771     75 4 04047     +         RTJ   SAD
          00 0 14301               00    FS1
00772     00 0 63341               00    FS6
          00 0 01464               00    LAPERR2
00773     75 4 04075     +         RTJ   SAH
          50 0 04073               ENI   SAD+24B
00774     50 0 04061               ENI   SAD+12B
          50 0 04061               ENI   SAD+12B
00775     75 0 00770               SLJ   LAPLAC2
          50 0 00000
00776     75 0 00000     HORIZ     SLJ   **
          50 4 00000               ENI   0,4
00777     12 4 04441     LOOP1     LDA   FS0,4
          14 4 14301               ADD   FS1,4
```

```
01000    01 0 00001              ARS    1
         20 4 53501              STA    FS5,4

01001    54 4 07600    +         ISK    7600B,4
         75 0 00777              SLJ    LOOP1

01002    75 0 00776              SLJ    HORIZ
         50 0 00000

01003    75 0 00000    MHAT      SLJ    **
         50 0 00000

01004    75 4 04214    +         RTJ    SAJ
         00 0 01462              00     HATERR

01005    50 0 43641              ENI    FS4
         50 0 63341              ENI    FS6

01006    75 4 04075    +         RTJ    SAH
         00 0 04223              00     SAJ+7B

01007    50 0 04223              ENI    SAJ+7B
         50 0 04223              ENI    SAJ+7B

01010    75 0 01003              SLJ    MHAT
         50 0 00000

01011    75 0 00000    UTHM1     SLJ    **
         50 0 00000

01012    75 4 04075    DIF1      RTJ    SAH
         00 0 01015              00     OUTSID1

01013    50 0 01017    +         ENI    INSID1
         50 0 01017              ENI    INSID1

01014    75 0 01011    +         SLJ    UTHM1
         50 0 00000

01015    10 0 00000    OUTSID1   ENA    0
         20 2 04441              STA    FS0,2

01016    75 0 01012              SLJ    DIF1
         50 0 00000

01017    12 2 43641    INSID1    LDA    FS4,2
         01 0 00001              ARS    1

01020    14 0 01434              ADD    CONST1
         20 0 01455              STA    LOCAT1

01021    26 0 01455              MUF    LOCAT1
         20 0 01455              STA    LOCAT1

01022    12 3 24141              LDA    FS2,3
         15 1 24141              SUB    FS2,1

01023    20 0 01456              STA    LOCAT2
         12 0 01435              LDA    CONST2

01024    26 2 63341              MUF    FS6,2
         26 0 01456              MUF    LOCAT2

01025    27 0 01455              DVF    LOCAT1
         27 2 24141              DVF    FS2,2

01026    20 2 04441              STA    FS0,2
         75 0 01012              SLJ    DIF1

01027    75 0 00000    UTHM2     SLJ    **
         50 0 00000
```

```
01030   75 4 04075   DIF2      RTJ   SAH
        00 0 01033             00    OUTSID2
01031   50 0 01035   +         ENI   INSID2
        50 0 01035             ENI   INSID2
01032   75 0 01027   +         SLJ   UTHM2
        50 0 00000
01033   10 0 00000   OUTSID2   ENA   0
        20 2 14301             STA   FS1,2
01034   75 0 01030             SLJ   DIF2
        50 0 00000
01035   12 2 43641   INSID2    LDA   FS4,2
        01 0 00001             ARS   1
01036   14 0 01434             ADD   CONST1
        20 0 01455             STA   LOCAT1
01037   26 0 01455             MUF   LOCAT1
        20 0 01455             STA   LOCAT1
01040   12 3 34001             LDA   FS3,3
        15 1 34001             SUB   FS3,1
01041   20 0 01456             STA   LOCAT2
        12 0 01435             LDA   CONST2
01042   26 2 63341             MUF   FS6,2
        26 0 01456             MUF   LOCAT2
01043   27 0 01455             DVF   LOCAT1
        27 2 34001             DVF   FS3,2
01044   20 2 14301             STA   FS1,2
        75 0 01030             SLJ   DIF2
01045   75 0 00000   OUTHM     SLJ   **
        50 4 00000             ENI   0,4
01046   12 4 04441   LOOP4     LDA   FS0,4
        15 4 14301             SUB   FS1,4
01047   20 4 04441             STA   FS0,4
        50 0 00000
01050   54 4 07600   +         ISK   7600B,4
        75 0 01046             SLJ   LOOP4
01051   75 0 01045             SLJ   OUTHM
        50 0 00000
01052   75 0 00000   VTHM1     SLJ   **
        50 0 00000
01053   75 4 04075   DIF3      RTJ   SAH
        00 0 01056             00    OUTSID3
01054   50 0 01060   +         ENI   INSID3
        50 0 01060             ENI   INSID3
01055   75 0 01052   +         SLJ   VTHM1
        50 0 00000
01056   10 0 00000   OUTSID3   ENA   0
        20 2 14301             STA   FS1,2
01057   75 0 01053             SLJ   DIF3
        50 0 00000
```

```
01060   12 2 43641   INSID3   LDA   FS4,2
        01 0 00001            ARS   1
01061   14 0 01434            ADD   CONST1
        20 0 01455            STA   LOCAT1
01062   26 0 01455            MUF   LOCAT1
        20 0 01455            STA   LOCAT1
01063   12 2 24142            LDA   FS2+1,2
        15 2 24140            SUB   FS2-1,2
01064   20 0 01456            STA   LOCAT2
        12 0 01435            LDA   CONST2
01065   26 2 63341            MUF   FS6,2
        26 0 01456            MUF   LOCAT2
01066   27 0 01455            DVF   LOCAT1
        27 2 24141            DVF   FS2,2
01067   20 2 14301            STA   FS1,2
        75 0 01053            SLJ   DIF3
01070   75 0 00000   VTHM2    SLJ   **
        50 0 00000
01071   75 4 04075   DIF4     RTJ   SAH
        00 0 01074            00    OUTSID4
01072   50 0 01076   +        ENI   INSID4
        50 0 01076            ENI   INSID4
01073   75 0 01070   +        SLJ   VTHM2
        50 0 00000
01074   10 0 00000   OUTSID4  ENA   0
        20 2 24141            STA   FS2,2
01075   75 0 01071            SLJ   DIF4
        50 0 00000
01076   12 2 43641   INSID4   LDA   FS4,2
        01 0 00001            ARS   1
01077   14 0 01434            ADD   CONST1
        20 0 01455            STA   LOCAT1
01100   26 0 01455            MUF   LOCAT1
        20 0 01455            STA   LOCAT1
01101   12 2 34002            LDA   FS3+1,2
        15 2 34000            SUB   FS3-1,2
01102   20 0 01456            STA   LOCAT2
        12 0 01435            LDA   CONST2
01103   26 2 63341            MUF   FS6,2
        26 0 01456            MUF   LOCAT2
01104   27 0 01455            DVF   LOCAT1
        27 2 34001            DVF   FS3,2
01105   20 2 24141            STA   FS2,2
        75 0 01071            SLJ   DIF4
01106   75 0 00000   DVTHM    SLJ   **
        50 4 00000            ENI   0,4
01107   12 4 24141   LOOP7    LDA   FS2,4
        15 4 14301            SUB   FS1,4
```

```
01110    20 4 14301                STA    FS1,4
         50 0 00000
01111    54 4 07600     +          ISK    7600B,4
         75 0 01107                SLJ    LOOP7
01112    75 0 01106                SLJ    DVTHM
         50 0 00000
01113    75 0 00000     DTHM       SLJ    **
         50 4 00000                ENI    0,4
01114    12 4 04441     LOOP8      LDA    FS0,4
         26 4 04441                MUF    FS0,4
01115    20 4 04441                STA    FS0,4
         12 4 14301                LDA    FS1,4
01116    26 4 14301                MUF    FS1,4
         14 4 04441                ADD    FS0,4
01117    75 4 04312     +          RTJ    VAB
         00 0 01466                00     SQFRR
01120    20 4 04441     +          STA    FS0,4
         50 0 00000
01121    54 4 07600     +          ISK    7600B,4
         75 0 01114                SLJ    LOOP8
01122    75 0 01113                SLJ    DTHM
         50 0 00000
01123    75 0 00000     KAT1       SLJ    **
         50 4 00000                ENI    0,4
01124    12 4 53501     LOOP9      LDA    FS5,4
         15 4 04441                SUB    FS0,4
01125    20 4 53501                STA    FS5,4
         50 0 00000
01126    54 4 07600     +          ISK    7600B,4
         75 0 01124                SLJ    LOOP9
01127    75 0 01123                SLJ    KAT1
         50 0 00000
01130    75 0 00000     UGEOS1     SLJ    **
         50 0 00000
01131    75 4 04075     DIF5       RTJ    SAH
         00 0 01134                00     OUTSID5
01132    50 0 01136     +          ENI    INSID5
         50 0 01136                ENI    INSID5
01133    75 0 01130     +          SLJ    UGEOS1
         50 0 00000
01134    10 0 00000     OUTSID5    ENA    0
         20 2 24141                STA    FS2,2
01135    75 0 01131                SLJ    DIF5
         50 0 00000
01136    12 2 43641     INSID5     LDA    FS4,2
         01 0 00001                ARS    1
01137    14 0 01434                ADD    CONST1
         20 0 01455                STA    LOCAT1
```

```
01140   26 0 01455            MUF   LOCAT1
        20 0 01455            STA   LOCAT1
01141   12 3 04441            LDA   FS0,3
        15 1 04441            SUB   FS0,1
01142   20 0 01456            STA   LOCAT2
        12 0 01435            LDA   CONST2
01143   26 2 63341            MUF   FS6,2
        26 0 01456            MUF   LOCAT2
01144   27 0 01455            DVF   LOCAT1
        20 2 24141            STA   FS2,2
01145   75 0 01131            SLJ   DIF5
        50 0 00000
01146   75 0 00000   UGEOS2   SLJ   **
        50 0 00000
01147   75 4 04075   DIF6     RTJ   SAH
        00 0 01152            00    OUTSID6
01150   50 0 01154   +        ENI   INSID6
        50 0 01154            ENI   INSID6
01151   75 0 01146   +        SLJ   UGEOS2
        50 0 00000
01152   10 0 00000   OUTSID6  ENA   0
        20 2 34001            STA   FS3,2
01153   75 0 01147            SLJ   DIF6
        50 0 00000
01154   12 2 43641   INSID6   LDA   FS4,2
        01 0 00001            ARS   1
01155   14 0 01434            ADD   CONST1
        20 0 01455            STA   LOCAT1
01156   26 0 01455            MUF   LOCAT1
        20 0 01455            STA   LOCAT1
01157   12 3 14301            LDA   FS1,3
        15 1 14301            SUB   FS1,1
01160   20 0 01456            STA   LOCAT2
        12 0 01435            LDA   CONST2
01161   26 2 63341            MUF   FS6,2
        26 0 01456            MUF   LOCAT2
01162   27 0 01455            DVF   LOCAT1
        20 2 34001            STA   FS3,2
01163   75 0 01147            SLJ   DIF6
        50 0 00000
01164   75 0 00000   UGEOS    SLJ   **
        50 4 00000            ENI   0,4
01165   12 4 24141   LOOP10   LDA   FS2,4
        05 0 00003            ALS   3
01166   20 0 01455            STA   LOCAT1
        12 4 34001            LDA   FS3,4
01167   05 0 00003            ALS   3
        14 0 01455            ADD   LOCAT1
```

```
01170   20 4 24141              STA   FS2,4
        50 0 00000
01171   54 4 07600    +         ISK   7600B,4
        75 0 01165              SLJ   LOOP10
01172   75 0 01164              SLJ   UGEOS
        50 0 00000
01173   75 0 00000    VGEOS1    SLJ   **
        50 0 00000
01174   75 4 04075    DIF7      RTJ   SAH
        00 0 01177              00    OUTSID7
01175   50 0 01201    +         ENI   INSID7
        50 0 01201              FNI   INSID7
01176   75 0 01173    +         SLJ   VGEOS1
        50 0 00000
01177   10 0 00000    OUTSID7   ENA   0
        20 2 34001              STA   FS3,2
01200   75 0 01174              SLJ   DIF7
        50 0 00000
01201   12 2 43641    INSID7    LDA   FS4,2
        01 0 00001              ARS   1
01202   14 0 01434              ADD   CONST1
        20 0 01455              STA   LOCAT1
01203   26 0 01455              MUF   LOCAT1
        20 0 01455              STA   LOCAT1
01204   12 2 04442              LDA   FS0+1,2
        15 2 04440              SUB   FS0-1,2
01205   20 0 01456              STA   LOCAT2
        12 0 01435              LDA   CONST2
01206   26 2 63341              MUF   FS6,2
        26 0 01456              MUF   LOCAT2
01207   27 0 01455              DVF   LOCAT1
        20 2 34001              STA   FS3,2
01210   75 0 01174              SLJ   DIF7
        50 0 00000
01211   75 0 00000    VGEOS2    SLJ   **
        50 0 00000
01212   75 4 04075    DIF8      RTJ   SAH
        00 0 01215              00    OUTSID8
01213   50 0 01217    +         ENI   INSID8
        50 0 01217              FNI   INSID8
01214   75 0 01211    +         SLJ   VGEOS2
        50 0 00000
01215   10 0 00000    OUTSID8   ENA   0
        20 2 04441              STA   FS0,2
01216   75 0 01212              SLJ   DIF8
        50 0 00000
01217   12 2 43641    INSID8    LDA   FS4,2
        01 0 00001              ARS   1
```

```
01220    14 0 01434              ADD   CONST1
         20 0 01455              STA   LOCAT1
01221    26 0 01455              MUF   LOCAT1
         20 0 01455              STA   LOCAT1
01222    12 2 14302              LDA   FS1+1,2
         15 2 14300              SUB   FS1-1,2
01223    20 0 01456              STA   LOCAT2
         12 0 01435              LDA   CONST2
01224    26 2 63341              MUF   FS6,2
         26 0 01456              MUF   LOCAT2
01225    27 0 01455              DVF   LOCAT1
         20 2 04441              STA   FS0,2
01226    75 0 01212              SLJ   DIF8
         50 0 00000
01227    75 0 00000    VGEOS     SLJ   **
         50 4 00000              ENI   0,4
01230    12 4 34001    LOOP11    LDA   FS3,4
         05 0 00003              ALS   3
01231    20 0 01455              STA   LOCAT1
         12 4 04441              LDA   FS0,4
01232    05 0 00003              ALS   3
         14 0 01455              ADD   LOCAT1
01233    20 4 04441              STA   FS0,4
         50 0 00000
01234    54 4 07600    +         ISK   7600B,4
         75 0 01230              SLJ   LOOP11
01235    75 0 01227              SLJ   VGEOS
         50 0 00000
01236    75 0 00000    KINETIC   SLJ   **
         50 4 00000              ENI   0,4
01237    12 4 24141    LOOP12    LDA   FS2,4
         26 4 24141              MUF   FS2,4
01240    20 0 01455              STA   LOCAT1
         12 4 04441              LDA   FS0,4
01241    26 4 04441              MUF   FS0,4
         20 0 01456              STA   LOCAT2
01242    14 0 01455              ADD   LOCAT1
         01 0 00001              ARS   1
01243    20 4 04441              STA   FS0,4
         50 0 00000
01244    54 4 07600    +         ISK   7600B,4
         75 0 01237              SLJ   LOOP12
01245    75 0 01236              SLJ   KINETIC
         50 0 00000
01246    75 0 00000    KAT2      SLJ   **
         50 4 00000              ENI   0,4
01247    12 4 53501    LOOP13    LDA   FS5,4
         15 4 04441              SUB   FS0,4
```

```
01250    20 4 04441              STA     FS0,4
         50 0 00000
01251    54 4 07600    +         ISK     7600B,4
         75 0 01247              SLJ     LOOP13
01252    75 0 01246              SLJ     KAT2
         50 0 00000
01253    75 0 00000    LAYER2    SLJ     **
         12 0 01446              LDA     COUNT
01254    05 0 00001              ALS     1
         20 0 01446              STA     COUNT
01255    22 3 01253              AJPM    LAYER2
         12 0 01437              LDA     NAME1A
01256    20 0 01436              STA     NAME1
         12 0 01441              LDA     NAME2A
01257    20 0 01440              STA     NAME2
         12 0 01443              LDA     NAME3A
01260    20 0 01442              STA     NAME3
         12 0 01445              LDA     NAME4A
01261    20 0 01444              STA     NAME4
         12 0 01447              LDA     LEVEL2
01262    20 0 01316              STA     TITLE+3
         20 0 01341              STA     TITLE1+3
01263    20 0 01364              STA     TITLE2+3
         20 0 01407              STA     TITLE4+3
01264    20 0 01432              STA     TITLE7+3
         12 0 01450              LDA     A2
01265    20 0 01306              STA     A1
         12 0 01451              LDA     B2
01266    20 0 01307              STA     B1
         12 0 01452              LDA     C2
01267    20 0 01311              STA     C1
         12 0 01453              LDA     D2
01270    20 0 01310              STA     D1
         12 0 01454              LDA     E2
01271    61 0 01305              SAL     E1
         12 0 01457              LDA     TAPUNIT
01272    61 0 00664              SAL     HIGHD
         61 0 00712              SAL     HIGHT
01273    75 0 00601              SLJ     START
         50 0 00000
01274    75 0 00000    PRINT     SLJ     **
         10 0 77777              ENA     77777B
01275    20 0 00017              STA     17B
         50 0 00000
01276    75 0 01302    +         SLJ     *+4
         00 0 00000              00      0
01277    00 0 14301              00      FS1
         00 0 63341              00      FS6
```

```
01300   00 0 00047              00    39
        00 0 00035              00    29

01301   00 0 00022              00    18
        00 0 00010              00    8

01302   75 4 04371     +        RTJ   WAE
        00 0 00000              00    0

01303   75 4 02202     +        RTJ   MAC
        00 0 63341              00    FS6,0

01304   75 0 01274     +        SLJ   PRINT
        77 7 63341              77    FS6,7

01305   00 0 01460     F1       00    TAU
        00 0 00004              00    4

01306   13 1 11710     A1       OCT   1311171047640243
        47 6 40243

01307   02 4 76132     P1       OCT   0247613261070664
        61 0 70664

01310   00 1 42600     D1       OCT   0014260000000000
        00 0 00000

01311   01 3 56000     C1       OCT   0135600000000000
        00 0 00000

01312   00 0 00026              00    22
        00 0 00026              00    22

01313   20 4 34626     TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        65 5 12043

01314   65 2 56543     TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        20 3 12066

01315   71 6 54364     TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        20 2 02020

01316   43 6 13065     TITLE    BCD   4, LOWER LEVEL Z FIELD    LAYER 1
        51 2 00120

01317   75 0 01274              SLJ   PRINT
        50 0 00000

01320   75 0 00000     PRINT1   SLJ   **
        50 0 00000

01321   75 0 01325     +        SLJ   *+4
        00 0 00000              00    0

01322   00 0 53501              00    FS5
        00 0 63341              00    FS6

01323   00 0 00047              00    39
        00 0 00035              00    29

01324   00 0 00022              00    18
        00 0 00010              00    8

01325   75 4 04371     +        RTJ   WAE
        00 0 00000              00    0

01326   75 4 02202     +        RTJ   MAC
        00 0 63341              00    FS6,0

01327   75 0 01320              SLJ   PRINT1
        77 7 63341              77    FS6,7
```

```
01330   00 0 01460              00    TAU
        00 0 00001              00    1
01331   00 0 00000              OCT   0
        00 0 00000
01332   20 0 00000              DEC   50-1B47
        00 0 00000
01333   00 0 00000              OCT   0
        00 0 00000
01334   04 6 31463              DEC   150-2B47
        14 6 31463
01335   00 0 00026              00    22
        00 0 00026              00    22
01336   20 4 36147    TITLE1    BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        43 6 16371
01337   61 4 52046    TITLE1    BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        66 2 02546
01340   51 2 37163    TITLE1    BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        71 2 33020
01341   43 6 13065    TITLE1    BCD   4, LAPLACIAN OF VORTICITY LAYER 1
        51 2 00120
01342   75 0 01320              SLJ   PRINT1
        50 0 00000
01343   75 0 00000    PRINT2    SLJ   **
        50 0 00000
01344   75 0 01350    +         SLJ   *+4
        00 0 00000              00    0
01345   00 0 04441              00    FS0
        00 0 63341              00    FS6
01346   00 0 00047              00    39
        00 0 00035              00    29
01347   00 0 00022              00    18
        00 0 00010              00    8
01350   75 4 04371    SKIP      RTJ   WAE
        00 0 00000              00    0
01351   75 4 02202    +         RTJ   MAC
        00 0 63341              00    FS6,0
01352   75 0 01343              SLJ   PRINT2
        77 7 63341              77    FS6,7
01353   00 0 01460              00    TAU
        00 0 00001              00    1
01354   00 0 00000              OCT   0
        00 0 00000
01355   20 0 00000              DEC   50-1B47
        00 0 00000
01356   00 0 00000              OCT   0
        00 0 00000
01357   00 6 31463              DEC   250-3B47
        14 6 31463
```

```
01360    00 0 00026                  00    22
         00 0 00026                  00    22
01361    20 2 56551       TITLE2     BCD   4, VERT GRAD OF VT      LAYER 1
         23 2 06751
01362    61 6 42046       TITLE2     BCD   4, VERT GRAD OF VT      LAYER 1
         66 2 02523
01363    20 2 02020       TITLE2     BCD   4, VERT GRAD OF VT      LAYER 1
         20 2 02020
01364    43 6 13065       TITLE2     BCD   4, VERT GRAD OF VT      LAYER 1
         51 2 00120
01365    75 0 01343                  SLJ   PRINT2
         50 0 00000
01366    75 0 00000       PRINT3     SLJ   **
         50 0 00000
01367    75 0 01373       +          SLJ   **+4
         00 0 00000                  00    0
01370    00 0 04441                  00    FS0
         00 0 63341                  00    FS6
01371    00 0 00047                  00    39
         00 0 00035                  00    29
01372    00 0 00022                  00    18
         00 0 00010                  00    8
01373    75 4 04371       +          RTJ   WAE
         00 0 00000                  00    0
01374    75 4 02202       +          RTJ   MAC
         00 0 63341                  00    FS6,0
01375    75 0 01366                  SLJ   PRINT3
         77 7 63341                  77    FS6,7
01376    00 0 01460                  00    TAU
         00 0 00001                  00    1
01377    00 0 00000                  OCT   0
         00 0 00000
01400    20 0 00000                  DEC   5D-1847
         00 0 00000
01401    00 0 00000                  OCT   0
         00 0 00000
01402    01 4 63146                  DEC   5D-2847
         31 4 63146
01403    00 0 00026                  00    22
         00 0 00026                  00    22
01404    20 4 27145       TITLE4     BCD   4, KINETIC ENERGY       LAYER 1
         65 2 37163
01405    20 6 54565       TITLE4     BCD   4, KINETIC ENERGY       LAYER 1
         51 6 73020
01406    20 2 02020       TITLE4     BCD   4, KINETIC ENERGY       LAYER 1
         20 2 02020
01407    43 6 13065       TITLE4     BCD   4, KINETIC ENERGY       LAYER 1
         51 2 00120
```

```
01410    75 0 01366              SLJ    PRINT3
         50 0 00000
01411    75 0 00000    PRINT4    SLJ    **
         50 0 00000
01412    75 0 01416    +         SLJ    **4
         00 0 00000              00     0
01413    00 0 04441              00     FS0
         00 0 63341              00     FS6
01414    00 0 00047              00     39
         00 0 00035              00     29
01415    00 0 00022              00     18
         00 0 00010              00     8
01416    75 4 04371    +         RTJ    WAE
         00 0 00000              00     0
01417    75 4 02202    +         RTJ    MAC
         00 1 63341              00     FS6,0
01420    75 0 01411              SLJ    PRINT4
         77 7 63341              77     FS6,7
01421    00 0 01460              00     TAU
         00 0 00001              00     1
01422    00 0 00000              OCT    0
         00 0 00000
01423    20 0 00000              DEC    5D-1847
         00 0 00000
01424    00 0 00000              OCT    0
         00 0 00000
01425    03 1 46314              DEC    1D-1847
         63 1 46314
01426    00 0 00026              00     22
         00 0 00026              00     22
01427    20 4 75146    TITLE7    BCD    4, PROG KAT FIELD       LAYER 1
         67 2 04261
01430    23 2 06671    TITLE7    BCD    4, PROG KAT FIELD       LAYER 1
         65 4 36420
01431    20 2 02020    TITLE7    BCD    4, PROG KAT FIELD       LAYER 1
         20 2 02020
01432    43 6 13065    TITLE7    BCD    4, PROG KAT FIELD       LAYER 1
         51 2 00120
01433    75 0 01411              SLJ    PRINT4
         50 0 00000
01434    20 0 00000    CONST1    DEC    5D-1847
         00 0 00000
01435    05 5 11512    CONST2    DEC    17637D-5847
         62 5 77555
01436    64 2 02003    NAME1     OCT    6420200312122020
         12 1 22020
01437    64 2 02002    NAME1A    OCT    6420200212122020
         12 1 22020
```

```
01440   64 2 02005      NAME2     OCT   6420200512122020
        12 1 22020
01441   64 2 02003      NAME2A    OCT   6420200312122020
        12 1 22020
01442   23 2 02003      NAME3     OCT   2320200312122020
        12 1 22020
01443   23 2 02002      NAME3A    OCT   2320200212122020
        12 1 22020
01444   23 2 02005      NAME4     OCT   2320200512122020
        12 1 22020
01445   23 2 02003      NAME4A    OCT   2320200312122020
        12 1 22020
01446   17 7 77777      COUNT     OCT   1777777777777777
        77 7 77777
01447   43 6 13065      LEVEL2    OCT   4361306551200220
        51 2 00220
01450   07 2 47764      A2        OCT   0724776415014743
        15 0 14743
01451   01 0 30675      B2        OCT   0103067572026573
        72 0 26573
01452   02 7 34000      C2        OCT   0273400000000000
        00 0 00000
01453   77 0 12577      D2        OCT   7701257777777777
        77 7 77777
01454   00 0 00000      E2        OCT   2
        00 0 00002
01455        01456      LOCAT1    BSS   1
01456        01457      LOCAT2    BSS   1
01457   00 0 00000      TAPUNIT   OCT   50001200
        50 0 01200
01460   00 0 00000      TAU       DEC   24
        00 0 00030
01461   12 1 21205      TIME      OCT   1212120512010605
        12 0 10605
01462   76 0 01103      HATERR    SLS   MHAT
        50 0 00000
01463   76 0 00762      LAPERR1   SLS   LAPLAC1
        50 0 00000
01464   76 0 00770      LAPERR2   SLS   LAPLAC2
        50 0 00000
01465   76 0 00661      READERR   SLS   READD1
        50 0 00000
01466   76 0 01113      SQERR     SLS   DTHM
        50 0 00000
01467   76 0 00750      VORTER1   SLS   VORTIS1
        50 0 00000
```

```
01470     76 0 00755     VORTER2   SLS    VORTIS2
          50 0 00000
01471     76 0 00735     WINDERR   SLS    REWIND
          50 0 00000
01472          02202     MAA       LIB    MAA
02202          03707     MAC       LIB    MAC
03707          04047     MAG       LIB    MAG
04047          04075     SAD       LIB    SAD
04075          04161     SAH       LIB    SAH
04161          04214     SAI       LIB    SAI
04214          04235     SAJ       LIB    SAJ
04235          04312     SAR       LIB    SAR
04312          04341     VAB       LIB    VAB
04341          04371     WAB       LIB    WAB
04371          04441     WAE       LIB    WAE
04441          14301     FS0       BSS    4000
14301          24141     FS1       BSS    4000
24141          34001     FS2       BSS    4000
34001          43641     FS3       BSS    4000
43641          53501     FS4       BSS    4000
53501          63341     FS5       BSS    4000
63341          73201     FS6       BSS    4000
73201          00000               END
```

10. APPENDIX E

PRINTED FIELDS FROM THE CLEAR AIR TURBULENCE FORECAST COMPUTER PROGRAM FOR 00Z 10 MARCH 65 THROUGH 12Z 13 MARCH 65

```
L       I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
LJ021   +433 +358 +322 +299 +311 +342 +353 +345 +330 +311 +276 +216 +138 +064 +015 +013 +079 +203 +328 +400 +440 +497
LJ020   +491 +472 +442 +427 +377 +418 +437 +444 +428 +392 +340 +271 +169 + 53 +998 +028 +126 +263 +355 +382 +415 +476
                       77 77777                    77777      666    55    44               44    55   6666
             88888888888                     888888888        7777      666   555   44      333333     444   55   666666
 J019   +604 +602 +591 +591 +572 +56? +577 +595 +556 +476 +378 +26  +123 +100 +948 +991 +115 +251 +308 +328 +385 +436
             11111111111                                 888    777   666   55   44    3333333333   44   55        6666666666
             11111111111111111111111111111111111     888    77    666   55   44   33333333333   44   555            6666
 J018   +637 +718 +726 +734 +733 +723 +706 +677 +611 +511 +393 +254 +103 +171 +913 +951 +071 +198 +233 +245 +318 +380
                          2222222222             1111       888   777   666   55   44   3333         3333    44    55555555       6
             22222222222222222222222222             111      888    777   666   55   444    3333     33333   444   5555555555
 J017   +762 +786 +801 +805 +815 +801 +767 +674 +562 +470 +373 +271 +148 +013 +926 +946 +034 +149 +202 +221 +279 +334
             2222222222222222222222222       11     88        777       666     555   44     3333333333     44     555555
             222                 2222222222      11     88     7777      6666     55   44     33333333     444     5555         6
 J016   +797 +818 +831 +831 +814 +774 +742 +617 +483 +399 +344 +288 +199 +077 +980 +968 +053 +170 +241 +274 +301 +314
                                2222222222     111   88    777         666666         555   444          333      44     555       6666666
                               222222222     111    88     777        66666666       555   4444                  44    555      6666666666
 J015   +801 +821 +824 +803 +778 +745 +674 +552 +434 +354 +323 +301 +217 +106 +029 +035 +138 +248 +301 +325 +332 +315
             2222222222222             111    88    777      666666666666      555     4444444444     555     66666666666
             222222222222               1111    888    77     6666666666666     555     44444444      555    66666666
 J014   +765 +774 +771 +751 +719 +685 +624 +528 +414 +314 +297 +301 +219 +119 +102 +161 +253 +322 +349 +361 +361 +347
                                 1111111        8888     77     6666666666666          555                  5555      66666
                              11111111        8888     77     6666666666666          55555555555555           6666
 J013   +702 +693 +657 +633 +672 +628 +580 +522 +426 +330 +303 +204 +236 +194 +210 +261 +325 +375 +399 +410 +413 +417
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             111111111111111            888888      7777        6666666                                 666666            777777777777
 J012   +638 +622 +617 +624 +622 +582 +529 +486 +444 +394 +335 +271 +239 +242 +268 +302 +345 +386 +419 +453 +485 +515
                                   88888          7777777       6666                                  6666666          7777777
                   888888         8888888        77777777      6666                                  6666666          777777      8
 J011   +590 +576 +561 +566 +578 +559 +513 +464 +431 +391 +312 +237 +217 +233 +272 +326 +359 +373 +410 +478 +552 +609
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             8888888888888888888888888888                777777       6666          55                  666666             77777     888
 J010   +586 +569 +564 +575 +585 +577 +545 +500 +447 +384 +301 +235 +229 +249 +283 +329 +360 +379 +416 +487 +584 +665
               2                         88888888       77777       5566                           666666666              777777      888
                                       88888888      7777       66666                          6666666666              777777      888
 J009   +632 +618 +627 +641 +641 +623 +587 +548 +508 +459 +389 +318 +288 +293 +307 +330 +363 +400 +439 +504 +600 +690
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 J008   +691 +683 +693 +695 +691 +686 +641 +595 +563 +534 +488 +419 +368 +358 +362 +374 +397 +427 +474 +548 +634 +715
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                                      11111111          8888888      777777777777777777777777777777       8889       1
 J007   +737 +732 +735 +733 +734 +732 +704 +665 +632 +590 +546 +504 +461 +457 +455 +449 +447 +469 +527 +606 +685 +754
                                            111111111        888888888                                       88888      1111
                 222222222222222                  11111111         888888888888888888                          88888      1111
 J006   +770 +768 +773 +776 +777 +771 +750 +733 +717 +673 +625 +607 +578 +560 +552 +532 +515 +538 +596 +670 +741 +794
             22222222222222222222222222222                     1111111                        8888888888888888       1111
             22222222222222222222222222222222222222            11111111111                          88888        1111       2
 J005   +794 +795 +802 +809 +811 +806 +796 +789 +779 +750 +712 +687 +668 +655 +645 +621 +606 +626 +675 +735 +788 +823
             2222222222222222222222222222222222222222222                  11111111111111111111       11111111       2222
             22222222                             2222222222222              111111111111111        222222
 J004   +811 +814 +820 +827 +834 +836 +836 +833 +822 +798 +773 +752 +740 +735 +725 +704 +694 +711 +746 +786 +820 +842
             2                                          22222222222222222                                 22222222
                                                           22222222222222222222222222                 2222222222
 J003   +822 +826 +832 +838 +847 +853 +855 +857 +853 +839 +822 +809 +798 +791 +780 +765 +762 +777 +799 +821 +840 +853
                                                                   222222222222222222222222222222222222
                                                                         2222222222222222222222222222
 J002   +829 +834 +840 +844 +852 +867 +865 +870 +872 +867 +858 +847 +837 +824 +814 +806 +810 +819 +830 +838 +843 +848
                                                                                        222222222

 J001   +834 +835 +844 +848 +854 +861 +868 +875 +880 +879 +875 +865 +856 +840 +830 +830 +835 +840 +846 +844 +837 +837
LJ000   +838 +841 +846 +851 +854 +859 +866 +873 +880 +882 +880 +876 +867 +853 +842 +839 +844 +850 +853 +849 +840 +838
L       I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M      LOWER LEVEL 7 FIELD    LAYER 1         PROG.      24 HOURS        00Z 10 MARCH 1965
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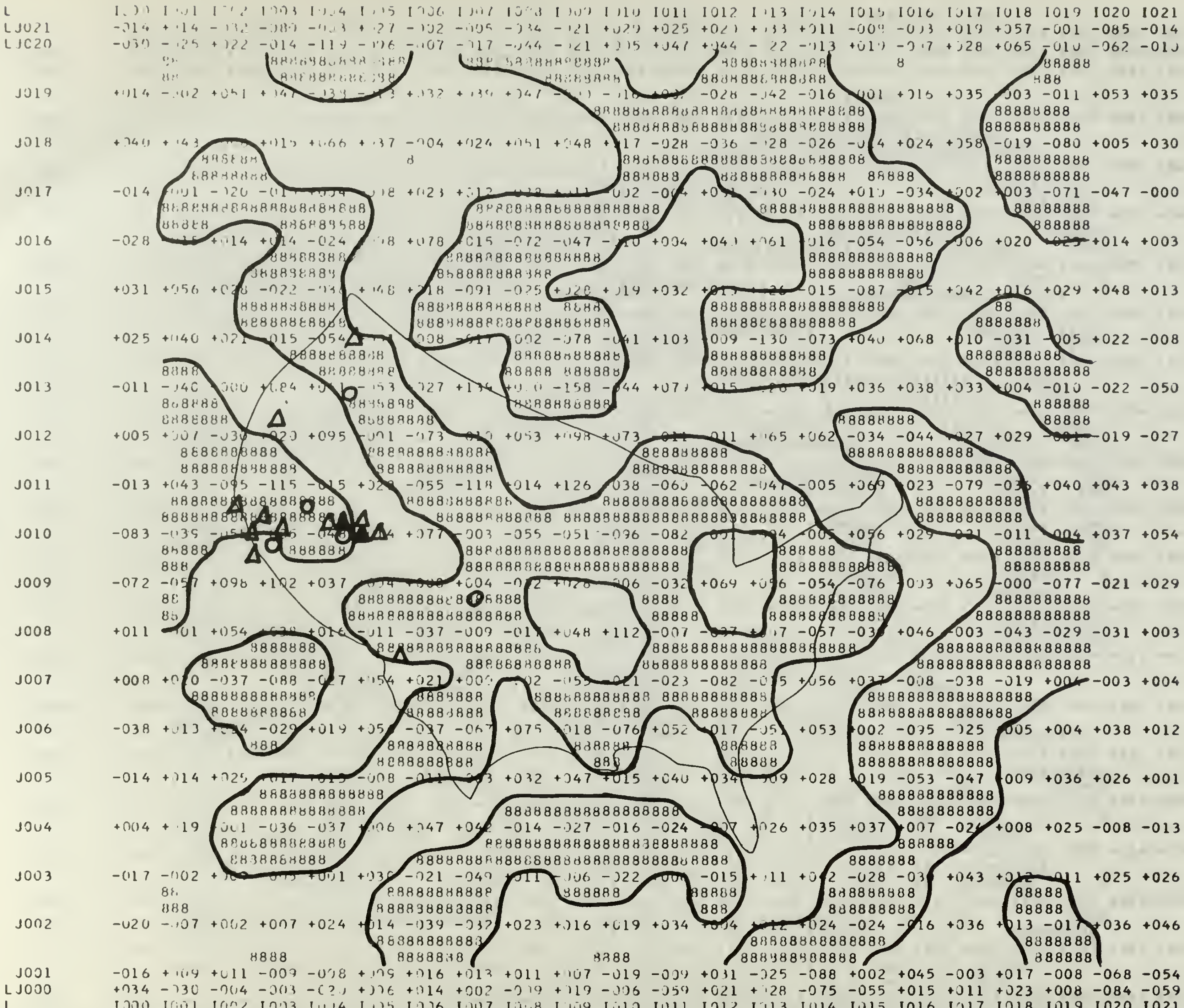
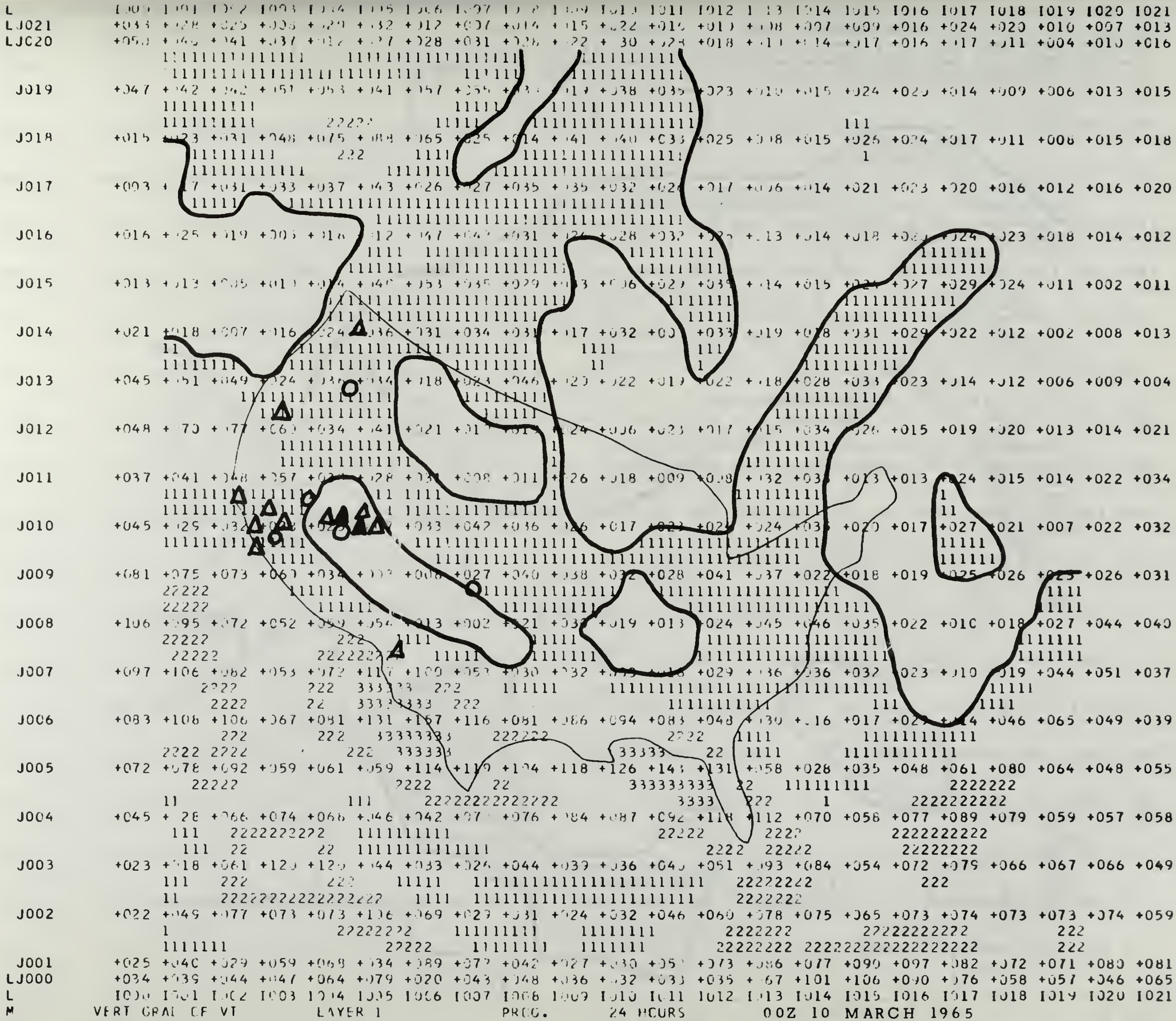
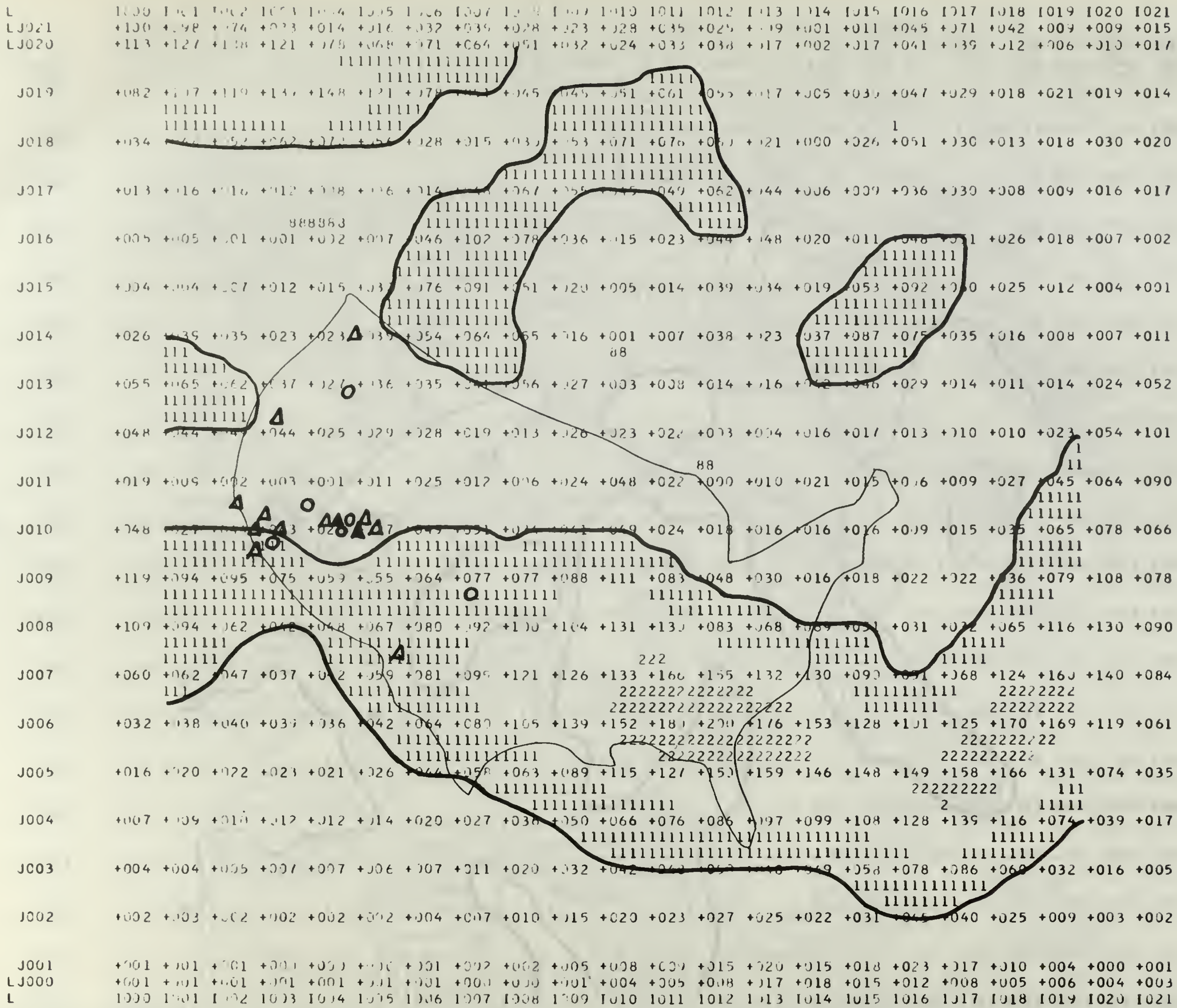
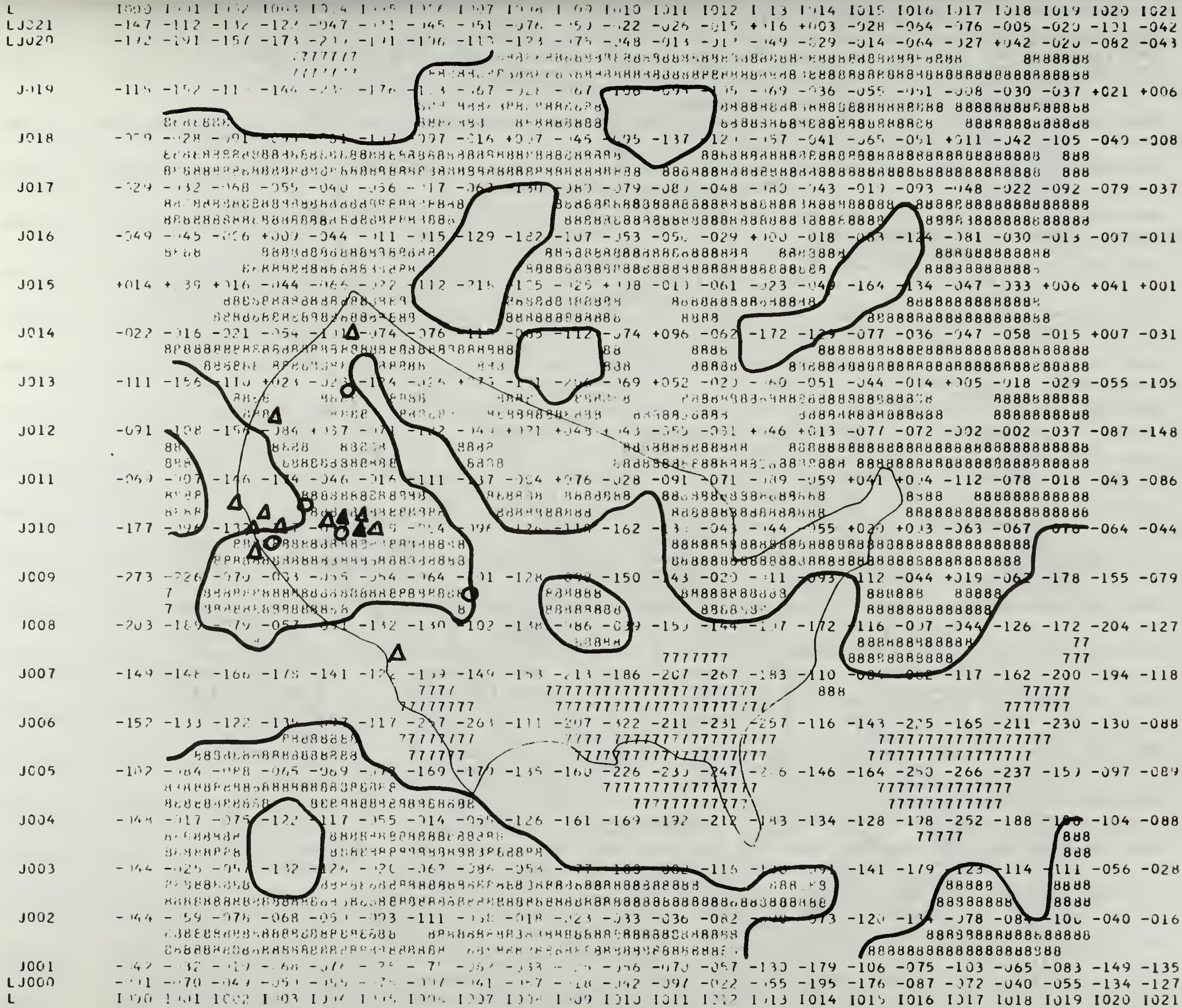


LAPLACIAN OF VORTICITY LAYER 1 PROG. 24 HOURS 00Z 10 MARCH 1965


VERT GRAD OF VT
LAYER 1
PROG.
24 HOURS
00Z 10 MARCH 1965



KINETIC ENERGY LAYER 1 PROG. 24 HOURS 00Z 10 MARCH 1965



PROG KAT FIELD LAYER 1 PROG. 24 HOURS 00Z 10 MARCH 1965

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L         1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021
LJ021     +891 +882 +876 +873 +876 +880 +882 +882 +881 +878 +872 +861 +848 +839 +835 +838 +848 +864 +879 +888 +892 +899
LJ020     +907 +900 +895 +889 +885 +893 +898 +901 +896 +889 +880 +865 +849 +835 +833 +842 +856 +872 +883 +887 +890 +899
               8888888               88888888888888       7777    666   55555555555      6666    777777777777
                  888 88888888888888888           88888      777    666   5555555555555    6666     77777777777
 J019     +924 +920 +913 +914 +911 +914 +921 +921 +914 +901 +883 +864 +843 +829 +829 +840 +855 +869 +876 +881 +888 +896
               1111                  1111111111      888    777   666   55555     55555    6666          777777
               1111111111111111111111111111111111      8888   777   666   55555      55555    6666          7777
 J018     +934 +934 +932 +932 +933 +935 +935 +931 +920 +906 +885 +863 +843 +829 +826 +834 +848 +862 +868 +872 +881 +890
                 11111111                 1111111    888    777   666   55555     555555    666666         7
                                            111111   8888   7777  666    55555     555555    666666
 J017     +938 +940 +940 +941 +942 +942 +939 +928 +913 +898 +883 +867 +851 +836 +827 +829 +840 +855 +864 +869 +876 +885
                                          1111   888     77777    6666    5555555   555555    66666
                                         1111  8888    777777     6666    555555555555555   6666           7
 J016     +941 +944 +945 +943 +942 +942 +936 +919 +900 +887 +879 +871 +859 +845 +833 +830 +840 +856 +868 +875 +880 +883
                                       1111   8888    777777777        6666     55555555555    6666        777777
                                      1111   8888    7777777777         6666     555555555    6666      77777777
 J015     +943 +945 +944 +945 +938 +936 +927 +908 +892 +882 +878 +874 +863 +848 +839 +841 +853 +867 +876 +882 +884 +883
                              1111111111     888    77777777777        6666              66666     7777777777
                           11111111111     8888    777777777 77       6666             6666     777777777777
 J014     +939 +935 +938 +936 +931 +927 +918 +905 +889 +877 +875 +875 +864 +850 +849 +858 +870 +878 +883 +886 +887 +885
               111111111111111111111         8888    77777                666666 6666666       77777777777777
               111111111111111111           88888    77777                6666666666666      777777777777
 J013     +930 +928 +928 +929 +926 +919 +912 +905 +891 +878 +875 +873 +866 +859 +862 +871 +880 +886 +889 +891 +892 +892
               1     11111111                 88888888     7777777        66666666        77777777
                                     888888888     7777777                666666         777777777
 J012     +921 +918 +916 +918 +919 +913 +904 +898 +893 +887 +878 +867 +863 +864 +871 +877 +883 +889 +894 +899 +903 +907
                                   8888888                  777777       6666666       777777777777        888888
                888888888          88888888                  77777       6666666666    777777777777        8888888
 J011     +916 +912 +909 +910 +912 +910 +902 +895 +892 +888 +877 +864 +859 +863 +872 +881 +885 +889 +897 +907 +916 +923
                88888888888        888888888                77777        6666666666    77777777777        88888
                                     8888888               777777        66666666      77777777           888888
 J010     +919 +916 +916 +917 +917 +916 +910 +899 +892 +886 +875 +866 +865 +867 +872 +880 +886 +891 +899 +910 +923 +933
                                         888888             777777                     777777777          88888
                   1111111111111          8888888             777777                   777777777         888888
 J009     +930 +927 +929 +931 +929 +925 +919 +909 +900 +893 +884 +877 +876 +875 +874 +879 +887 +894 +900 +911 +925 +938
               11111111111111111111111111         88888888        77777777777777777777777777777          888888
               1111          11111111111          88888888        7777777777777777777777777             888888    1
 J008     +942 +935 +940 +940 +938 +934 +928 +922 +915 +907 +899 +890 +886 +884 +883 +886 +892 +897 +904 +915 +929 +942
                                     1111111111         8888888               77                 888888    11
                                        1111111111         8888888                            8888888    111
 J007     +951 +949 +947 +946 +946 +944 +939 +933 +928 +921 +914 +906 +899 +898 +899 +899 +899 +904 +912 +924 +936 +947
               2222222222 222222                1111111111        888888888888888888888888888888888    11111
               222222222222222222222222             1111111111        8888888888888888888888888888    11111
 J006     +956 +956 +954 +953 +953 +952 +948 +943 +940 +935 +929 +924 +918 +915 +915 +912 +910 +914 +923 +934 +945 +952
               22222222222222222222222222222                 11111111111                      111111
               2222222222222222222222222222222222                 11111111111111111           111111
 J005     +960 +960 +960 +958 +958 +958 +956 +953 +950 +947 +943 +939 +936 +932 +930 +926 +923 +926 +935 +944 +951 +957
                        222222222222222222222222222222222                  1111111111111111111111          222
                                       2222222222222222222222222222222              1111111111111        22222
 J004     +963 +963 +963 +962 +962 +962 +961 +959 +956 +954 +951 +949 +947 +944 +942 +939 +937 +939 +944 +951 +956 +960
                                             2222222222222222222222222222222222                      222222222
                                                2222222222222222222222222222222222222               2222222222
 J003     +964 +965 +965 +965 +965 +965 +963 +961 +961 +959 +958 +956 +954 +952 +949 +947 +946 +948 +952 +955 +959 +961
                                                          222222222222222222222222222222222222222222222222222
                                                               2222222222222222222222222222222222222222222222
 J002     +965 +966 +966 +967 +967 +966 +965 +964 +964 +963 +962 +961 +959 +956 +954 +952 +953 +955 +956 +958 +960 +961
                                                                      2222222222222222222222222222222222222222
                                                                        222222222222222222222222222222222222222
 J001     +965 +966 +967 +967 +957 +967 +967 +967 +966 +966 +964 +963 +962 +959 +957 +956 +958 +959 +960 +960 +960 +961
LJ000     +965 +966 +966 +967 +967 +967 +967 +967 +967 +967 +966 +964 +964 +962 +960 +960 +961 +962 +962 +962 +961 +962
L         1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021
M       LOWER LEVEL Z FIELD    LAYER 2          PROG.       24 HOURS      00Z  10 MARCH 1965
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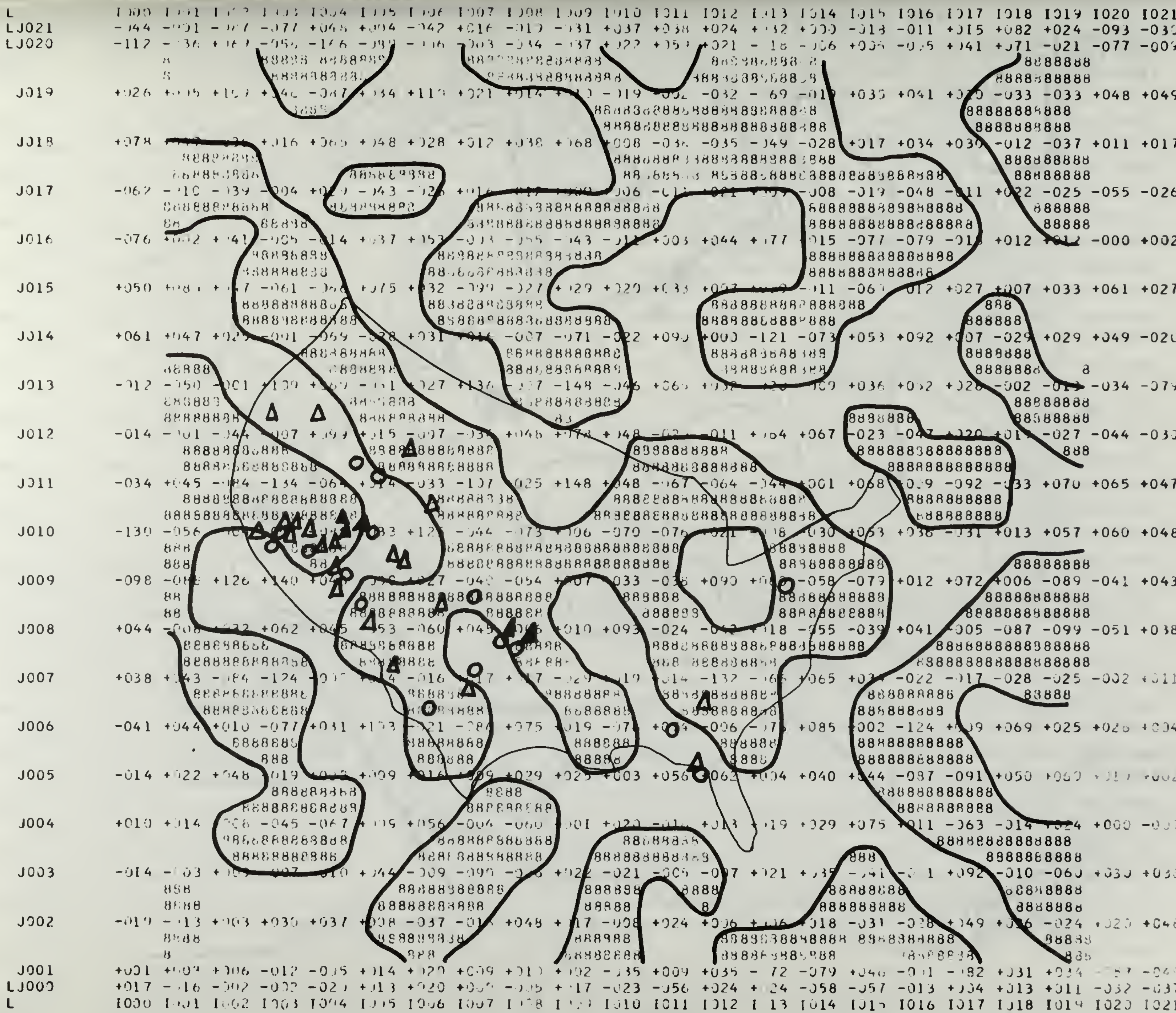
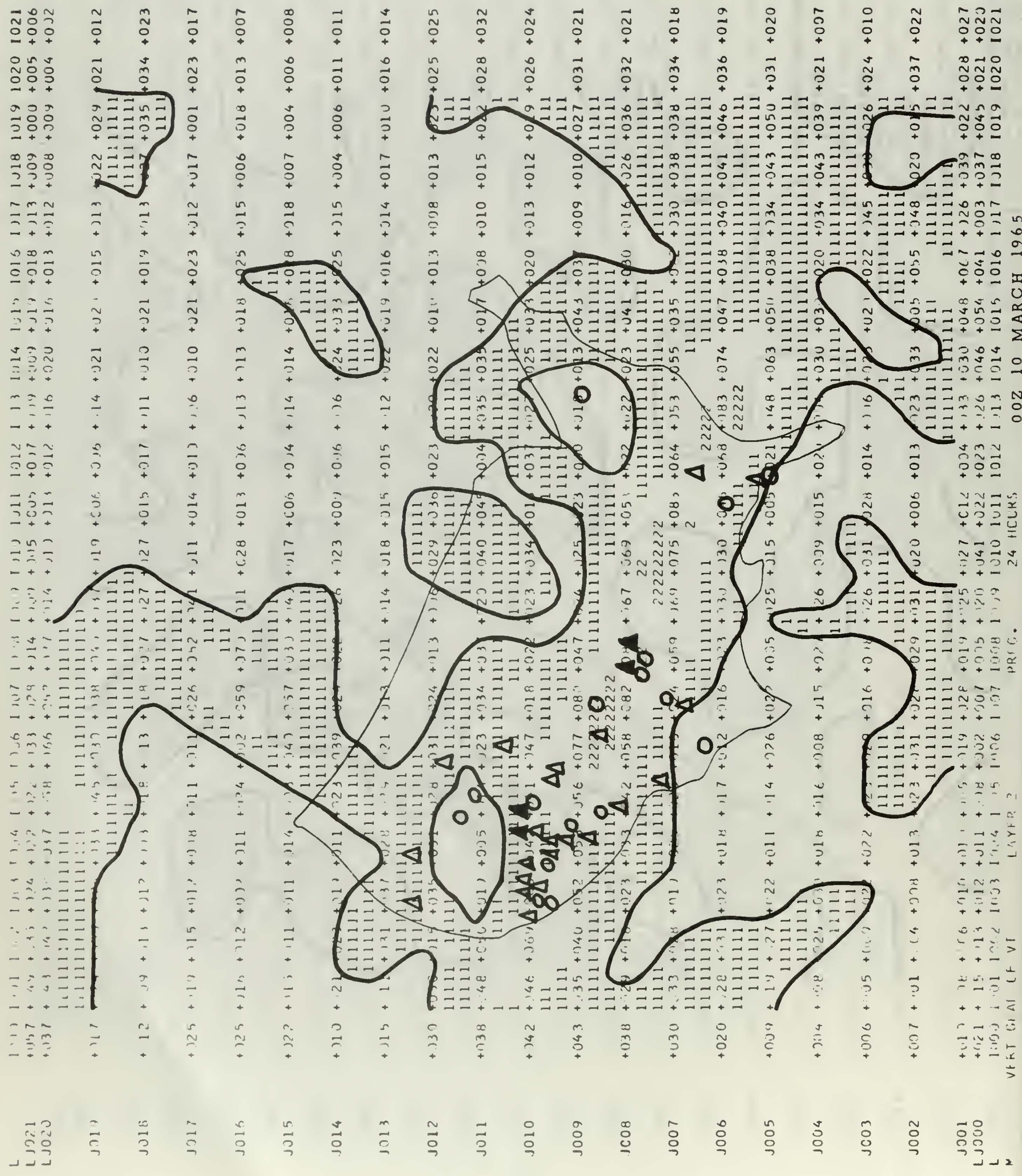
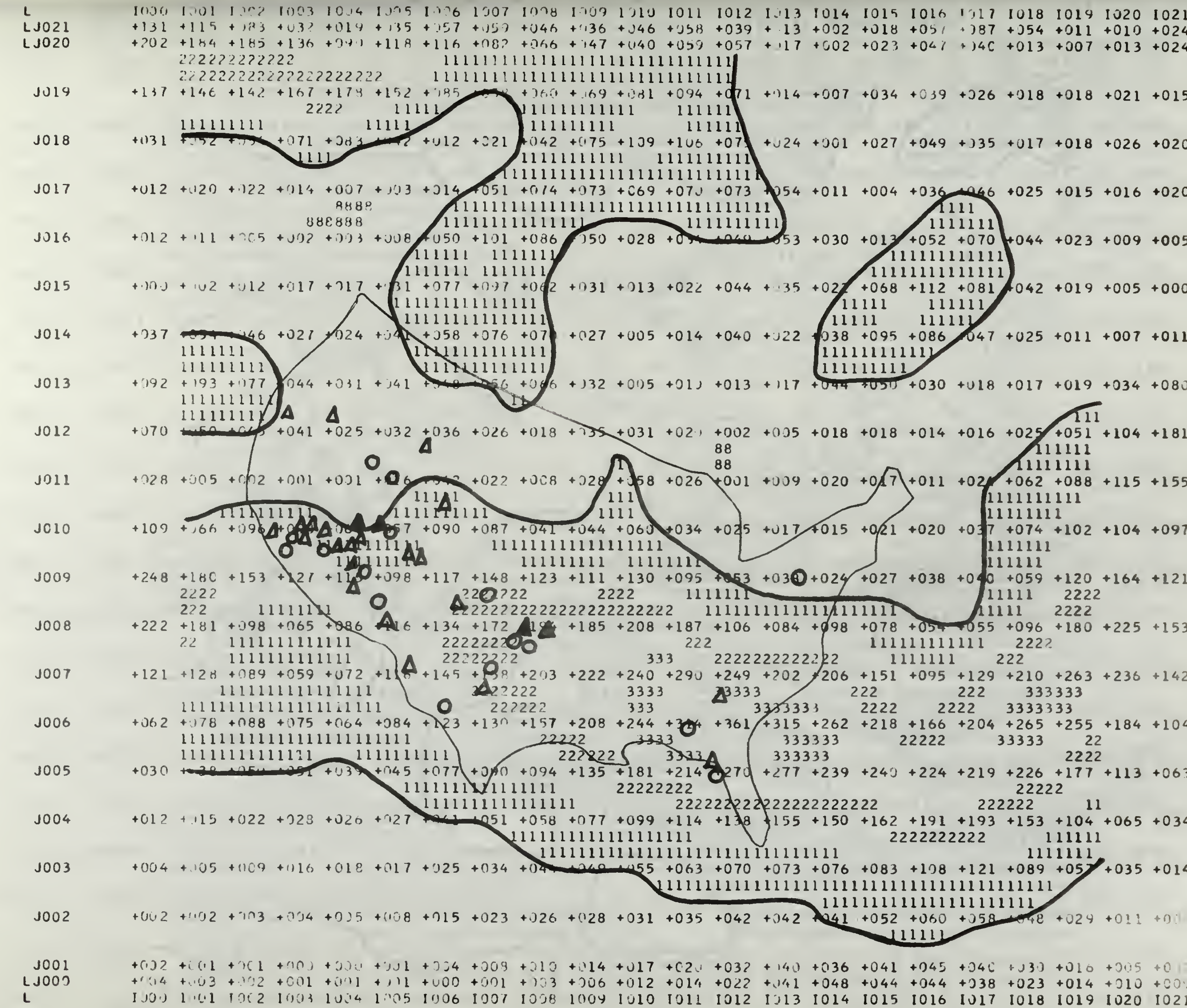
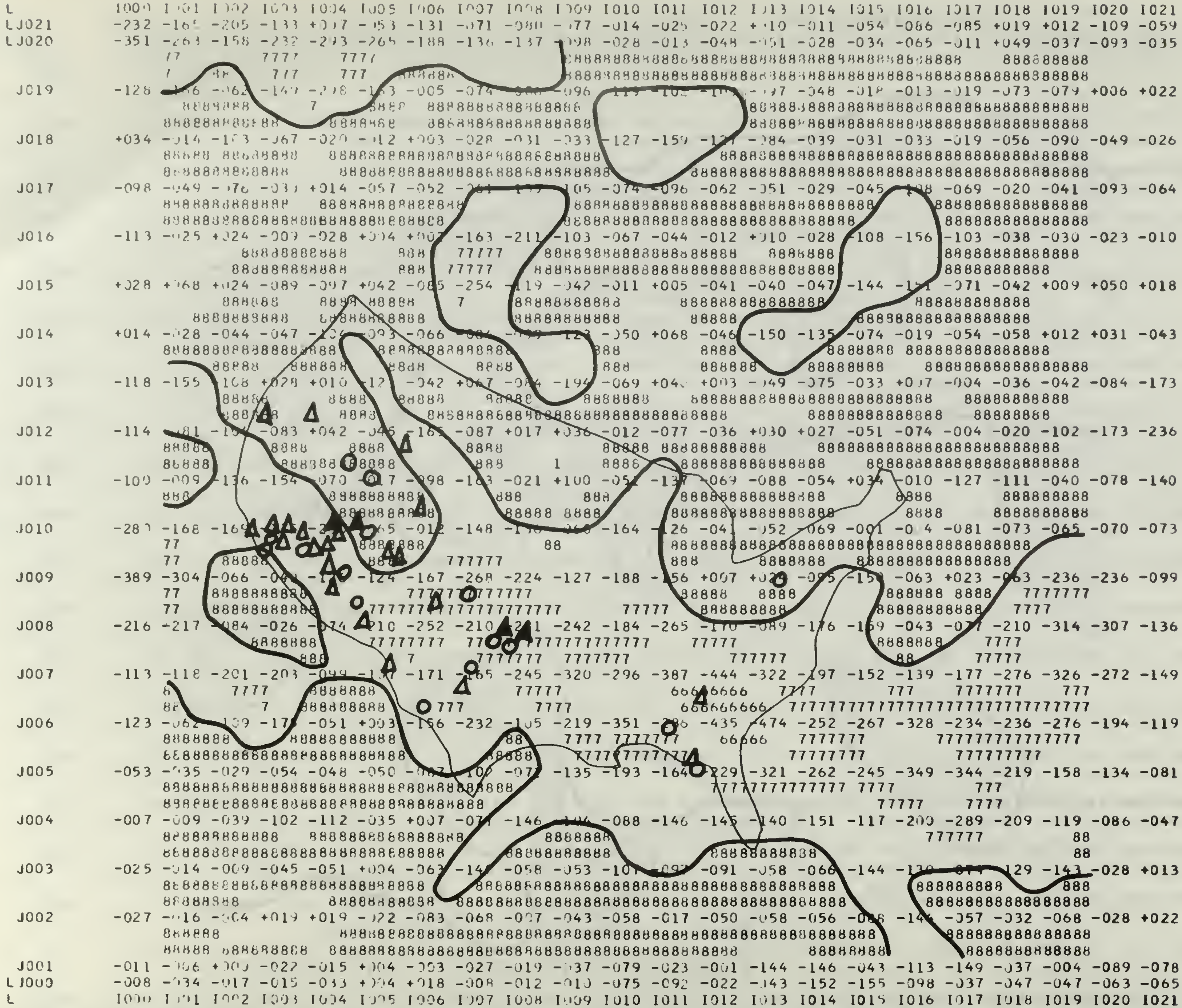


LAPLACIAN OF VORTICITY LAYER 2 PROG. 24 HOURS 00Z 10 MARCH 1965

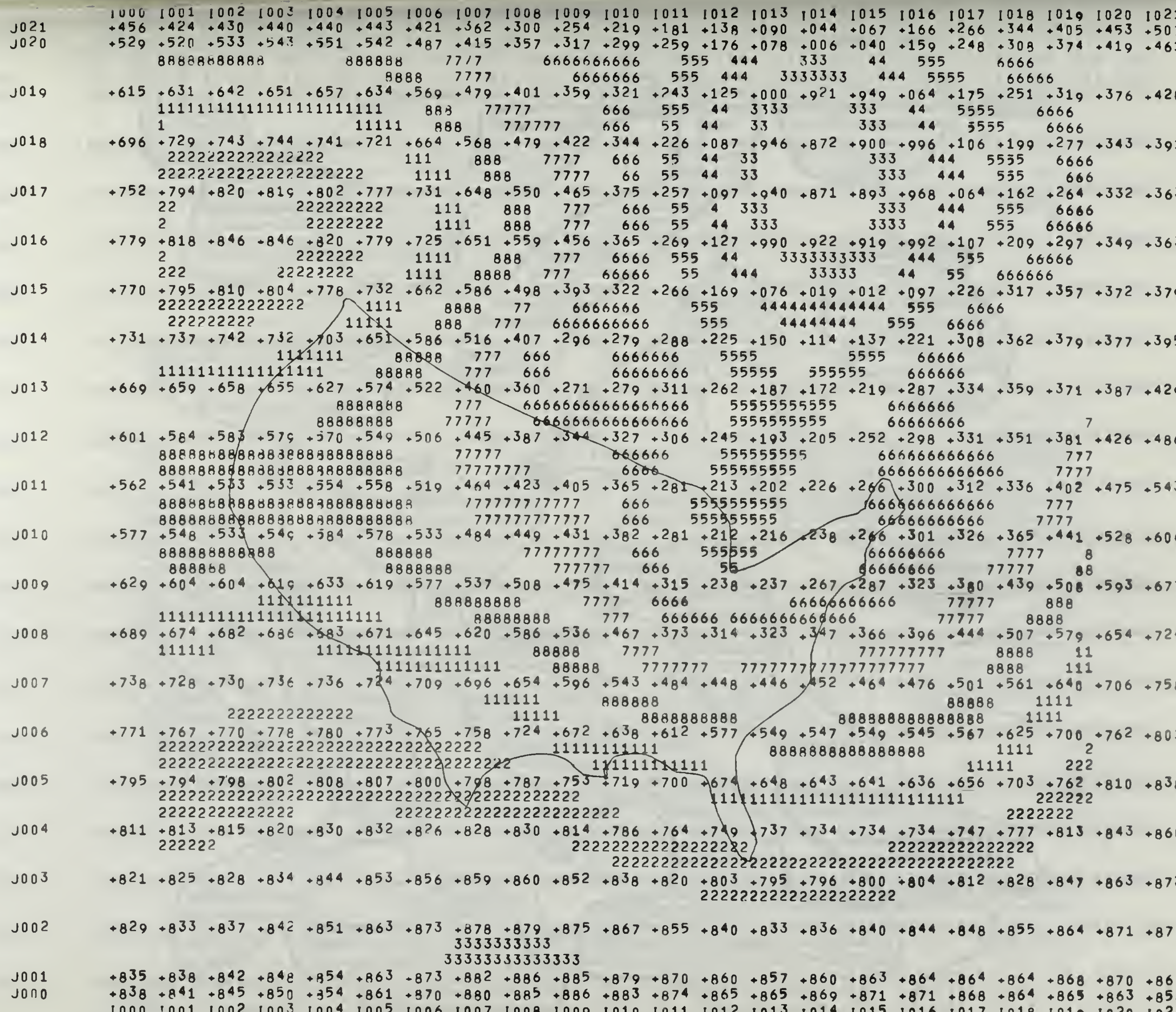

VERT CIR OF VT
LAYER 2
PROG.
24 HOURS
00Z 10 MARCH 1965



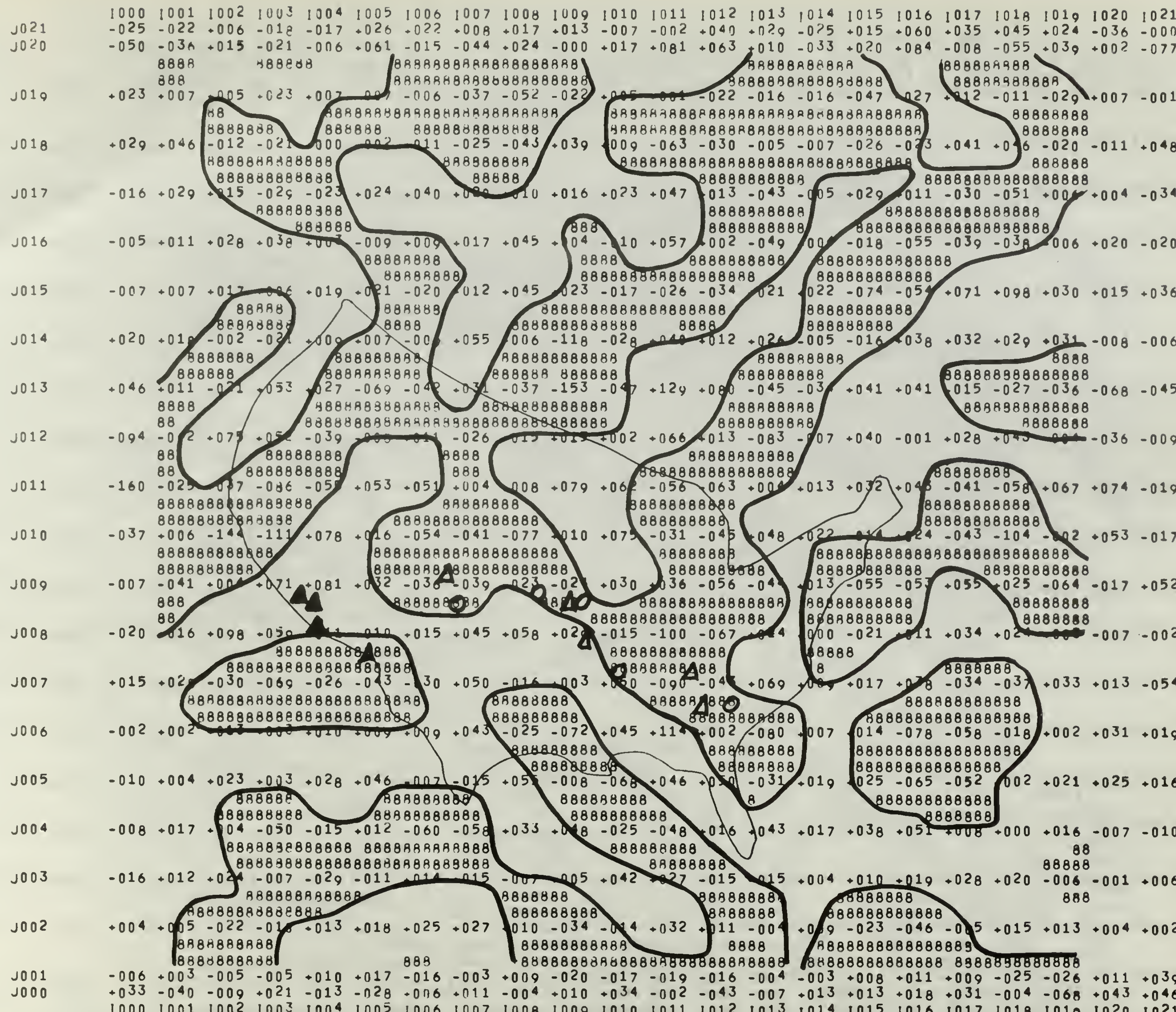
KINETIC ENERGY LAYER 2 PROG. 24 HOURS 00Z 10 MARCH 1965



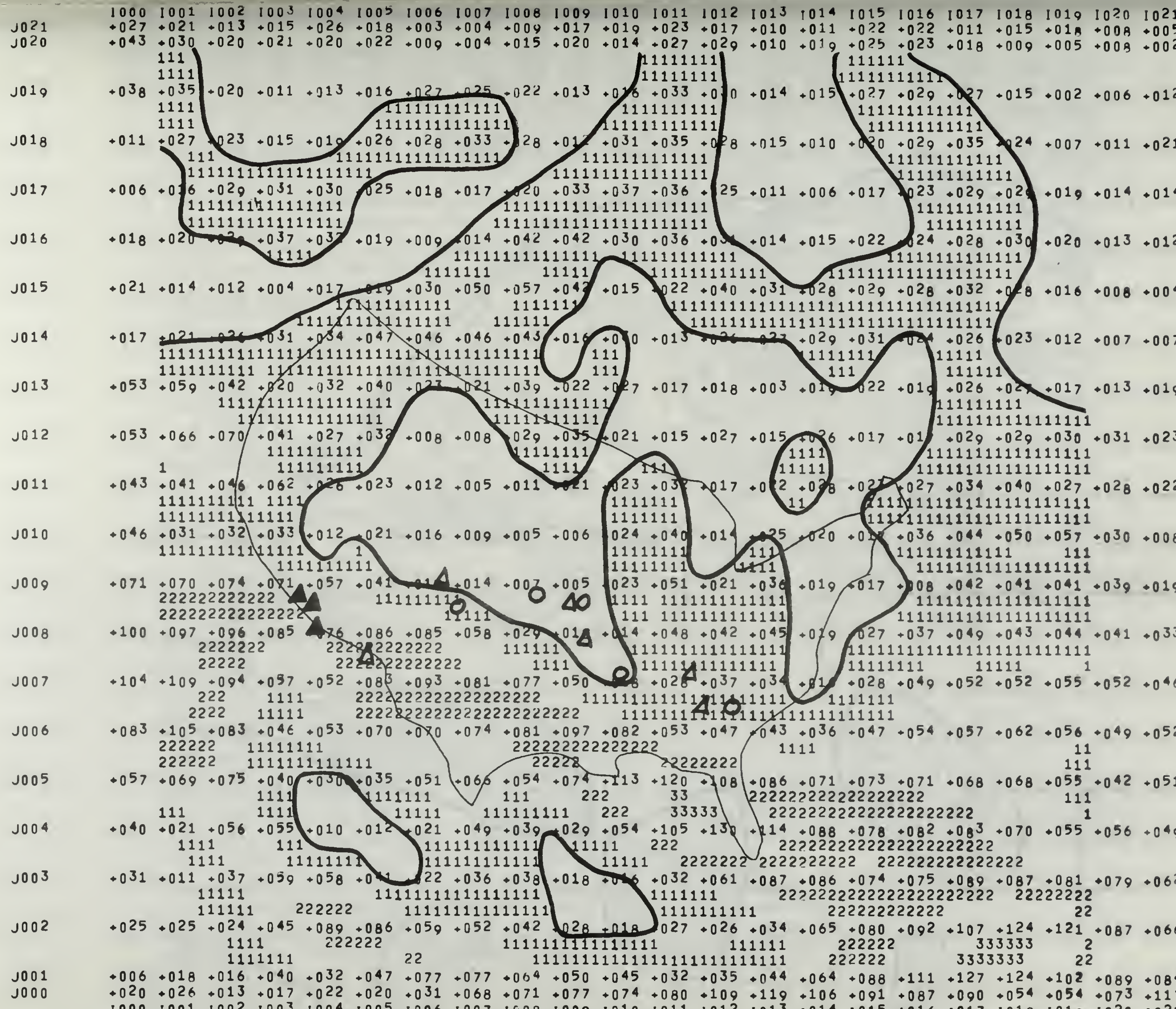
PROG KAT FIELD   LAYER 2   PROG.   24 HOURS   00Z 10 MARCH 1965



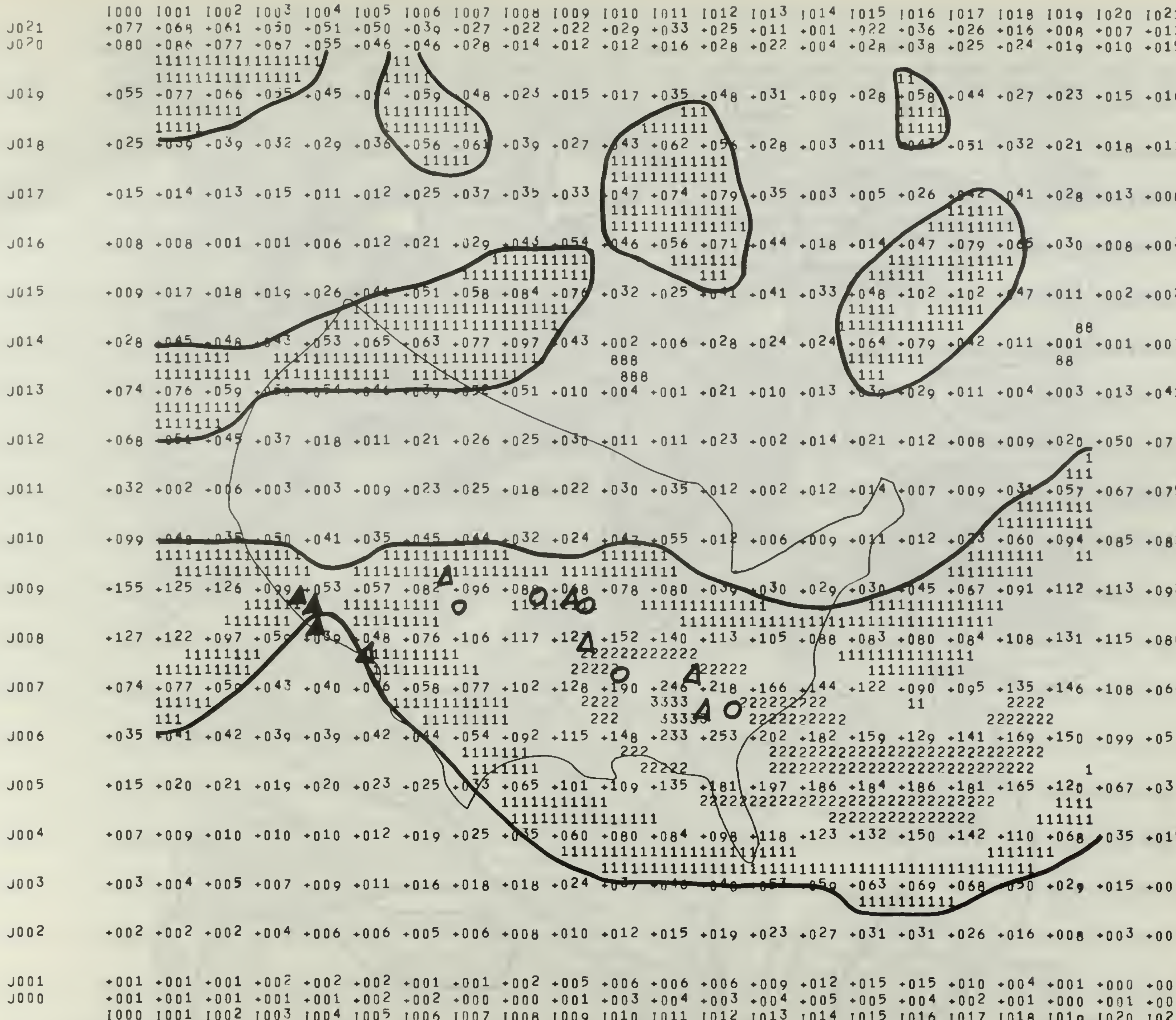
LOWER LEVEL Z FIELD   LAYER 1   PROG.   24 HOURS   12Z 10 MARCH 1965



LAPLACIAN OF VORTICITY LAYER 1 PROG. 24 HOURS 12Z 10 MARCH 1965



VERT GRAD OF VT LAYER 1 PROG. 24 HOURS 12Z 10 MARCH 1965



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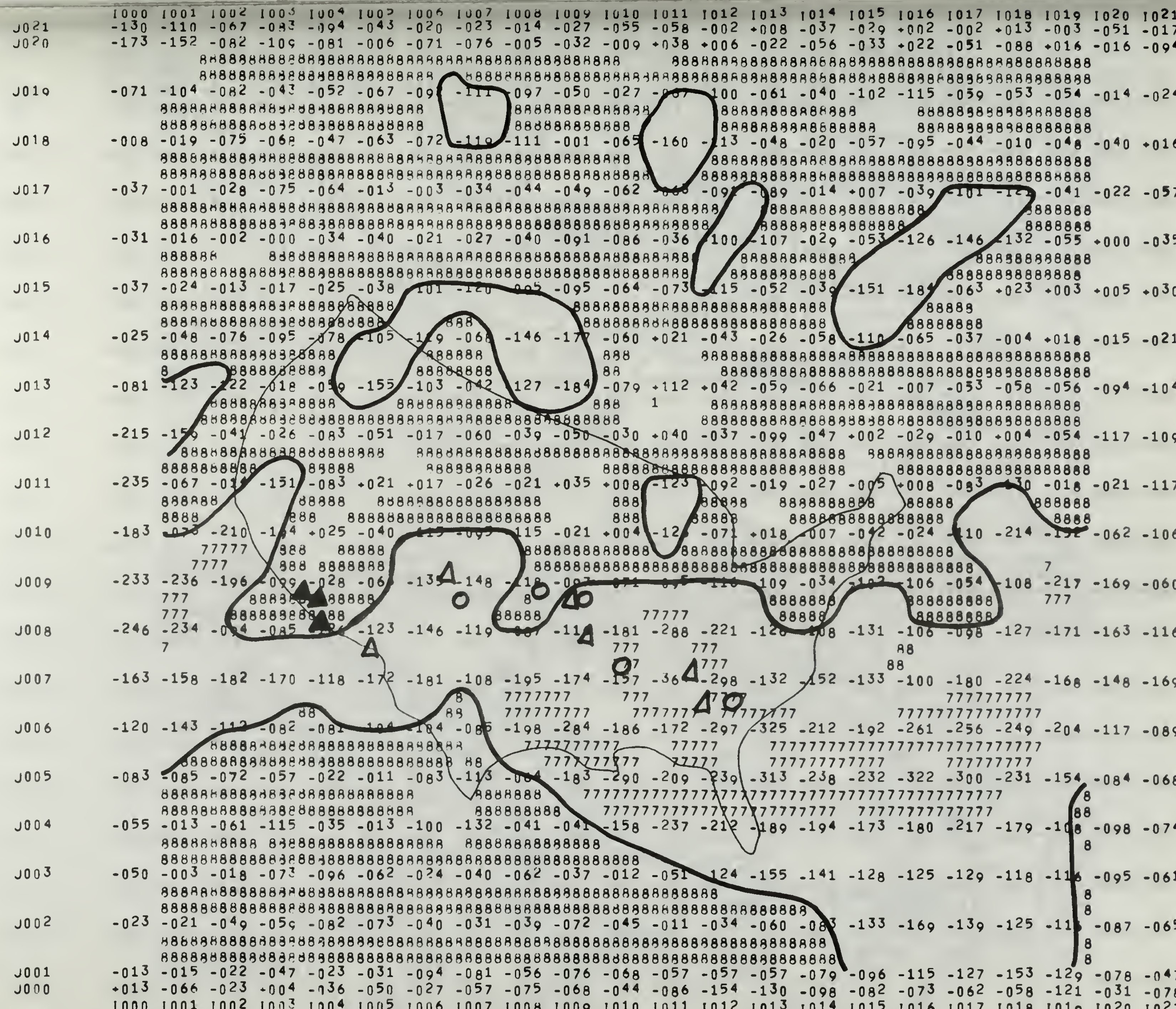

PROG KAT FIELD LAYER 1 PROG. 24 HOURS 12Z 10 MARCH 1965

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       I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
J021   +899 +893 +893 +892 +892 +891 +883 +876 +873 +870 +864 +858 +850 +839 +835 +845 +861 +873 +884 +892 +895 +900
J020   +913 +909 +909 +908 +907 +905 +895 +884 +881 +879 +875 +869 +856 +841 +835 +844 +858 +868 +877 +887 +891 +895
                       8888888888      777777777777777     6666     5555555555      66666       77777777
                           888888        77777777777777    6666     555555555555     66666       7777777
J019   +928 +926 +925 +924 +921 +916 +907 +895 +888 +886 +879 +866 +849 +835 +829 +832 +844 +859 +870 +879 +887 +893
            1111111111111111          88888          777777    666     555555       555555    66666      77777
            11111111111111111111       888888          7777    6666    555555        55555    6666       7777
J018   +936 +938 +937 +935 +932 +928 +920 +909 +901 +895 +883 +864 +844 +830 +824 +825 +835 +852 +865 +875 +884 +892
                          111111111111       88888888      7777    666   5555              55555   66666     777
                               111111111       888888      777     666   5555               5555   6666      777
J017   +939 +943 +944 +942 +940 +938 +931 +922 +912 +901 +887 +869 +847 +830 +824 +824 +832 +846 +861 +874 +882 +889
                                  1111111      88888     7777     666   5555               5555   6666     7777
                                   1111111     88888     7777     666   55555             55555   666     77777
J016   +940 +945 +947 +947 +944 +939 +933 +924 +914 +899 +884 +870 +851 +835 +828 +827 +835 +851 +867 +878 +884 +888
                                 11111111     8888     77777      666     5555555555555555     666     77777777
                                1111111      8868     77777      6666      55555555555555    666     7777777777
J015   +938 +942 +944 +944 +941 +934 +926 +916 +904 +888 +876 +867 +855 +844 +838 +837 +848 +866 +880 +886 +888 +889
                             1111111        8888     77777         666666                  6666    777777777777
                           11111111        88888    7/77          6666666                 6666    7777777777
J014   +934 +935 +935 +935 +931 +923 +914 +904 +889 +874 +870 +870 +863 +854 +849 +853 +864 +876 +885 +888 +888 +890
            111111111111111111         888888     777                 666666666 66666666       77777777777
            1111111111111111         8888888     7777                  666666666666666       777777777777
J013   +925 +923 +924 +925 +920 +912 +903 +894 +881 +870 +870 +874 +868 +857 +857 +865 +874 +880 +886 +889 +890 +895
                               88888888       77777                    666666666666       7777777777
                             888888888       7777777                  666666666666       7777777777
J012   +912 +910 +914 +915 +911 +907 +901 +892 +884 +877 +875 +873 +864 +857 +861 +871 +878 +883 +890 +896 +900 +907
            8888888888888888888888888       777777777777         666666666666             777777777       8888
            88888888888888888888888888       777777777777      666666666666             7777777777      88888
J011   +907 +904 +906 +908 +909 +909 +903 +895 +889 +886 +880 +870 +861 +858 +863 +871 +877 +882 +891 +904 +914 +919
            888888888888888888888888888           777777777      6666666666666            777777777      8888
            8888888888888        888888888           777777      66666666666             777777777      8888
J010   +914 +910 +909 +912 +917 +915 +908 +901 +894 +891 +884 +871 +862 +861 +865 +870 +876 +882 +891 +907 +920 +928
                                 888888888          77777     66666666                 77777777      8888
                      11111        888888888         77777        66                  7777777       8888
J009   +928 +923 +923 +927 +929 +926 +920 +913 +906 +898 +889 +876 +867 +866 +869 +873 +880 +889 +898 +911 +925 +936
            1111111111111111111111111111         8888888      77777                 7777777       88888     1
            11111111111111111111111111111111         88888     777777            7777777777      888888     11
J008   +940 +937 +937 +938 +937 +936 +932 +928 +921 +911 +899 +885 +879 +878 +879 +882 +889 +898 +908 +919 +932 +942
                                   111111111111      88888     77777777777777777777         888888     1111
                                        111111111     88888                                 8888888     11111
J007   +950 +948 +946 +944 +943 +942 +941 +939 +932 +925 +915 +903 +895 +894 +895 +896 +900 +907 +917 +929 +940 +948
            222222                                   111111111     888888888888888888888888888888888      11111
            22222222222222222222                       111111111     888888888888888888888888888       11111
J006   +956 +955 +953 +951 +951 +951 +949 +947 +942 +936 +931 +924 +916 +913 +912 +912 +912 +918 +928 +939 +948 +955
            2222222222222222222222222222222                 1111111111                     111111      2
            22222222222222222222222222222222222                  1111111111111111111     11111111      222
J005   +960 +960 +959 +957 +957 +957 +955 +953 +951 +947 +943 +939 +935 +932 +930 +929 +928 +932 +939 +948 +955 +960
                 22222222222222222222222222222222222222                      1111111111111111      222222
                   22222222222222222222222222222222222222222222222                                 22222222
J004   +962 +962 +962 +960 +960 +960 +960 +959 +958 +955 +952 +950 +948 +946 +945 +944 +944 +945 +950 +955 +959 +963
                                         2222222222222222222222222222222222222            222222222222222
                                              22222222222222222222222222222222222222222222222222222222222222222
J003   +964 +964 +964 +963 +962 +963 +963 +963 +962 +961 +959 +958 +956 +954 +953 +953 +953 +955 +957 +960 +963 +965
                                                         222222222222222222222222222222222222222222222
                                                             222222222222222222222222222222222222222
J002   +965 +965 +965 +965 +965 +966 +966 +966 +965 +963 +962 +961 +960 +959 +959 +958 +958 +960 +961 +963 +965 +966
                                                                           2222222222

J001   +965 +965 +965 +966 +966 +967 +967 +967 +967 +965 +964 +963 +962 +962 +962 +962 +963 +963 +963 +964 +965 +965
J000   +965 +965 +966 +966 +966 +967 +968 +968 +968 +967 +966 +964 +964 +964 +965 +965 +965 +965 +965 +964 +965 +965
       I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
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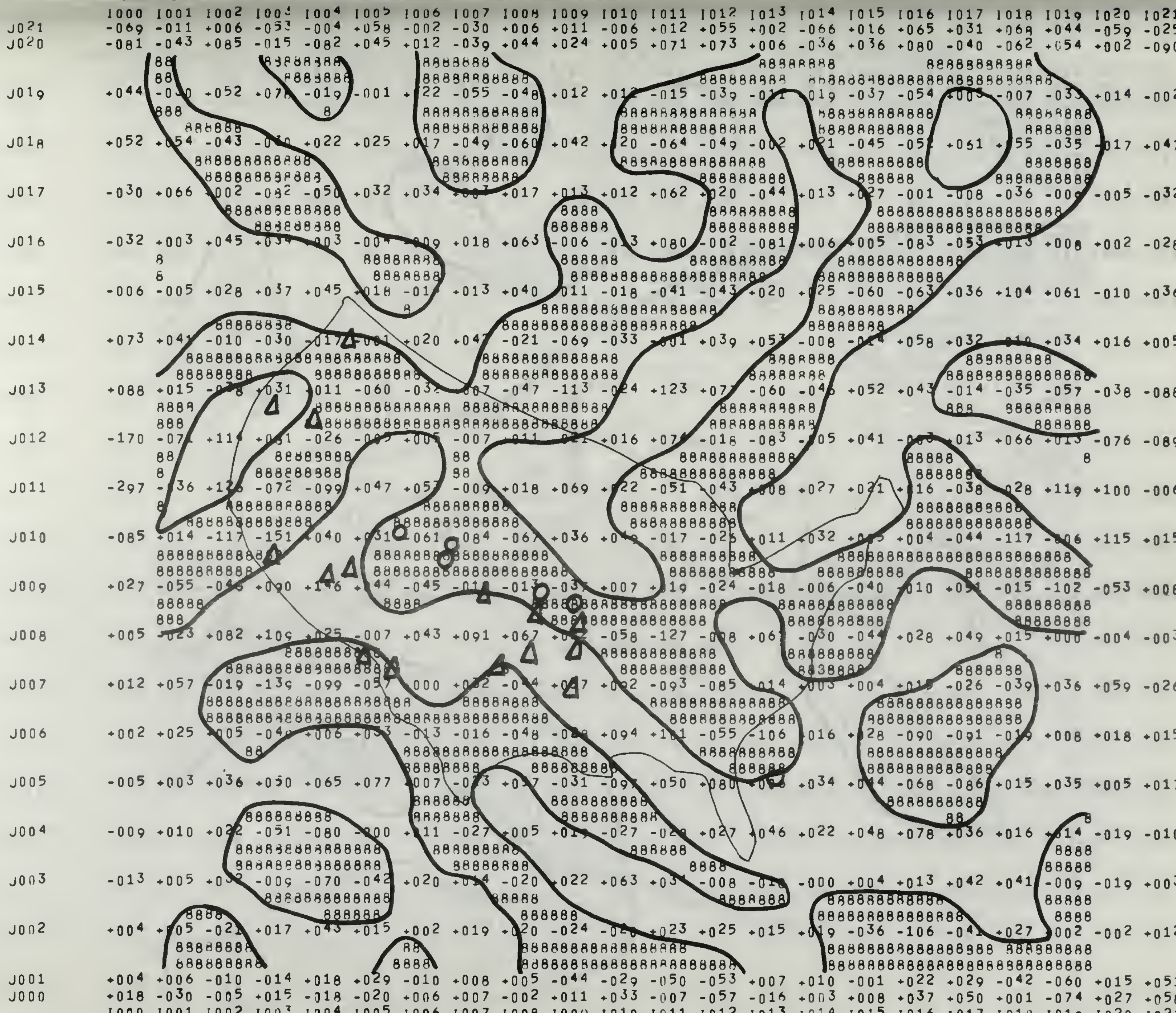
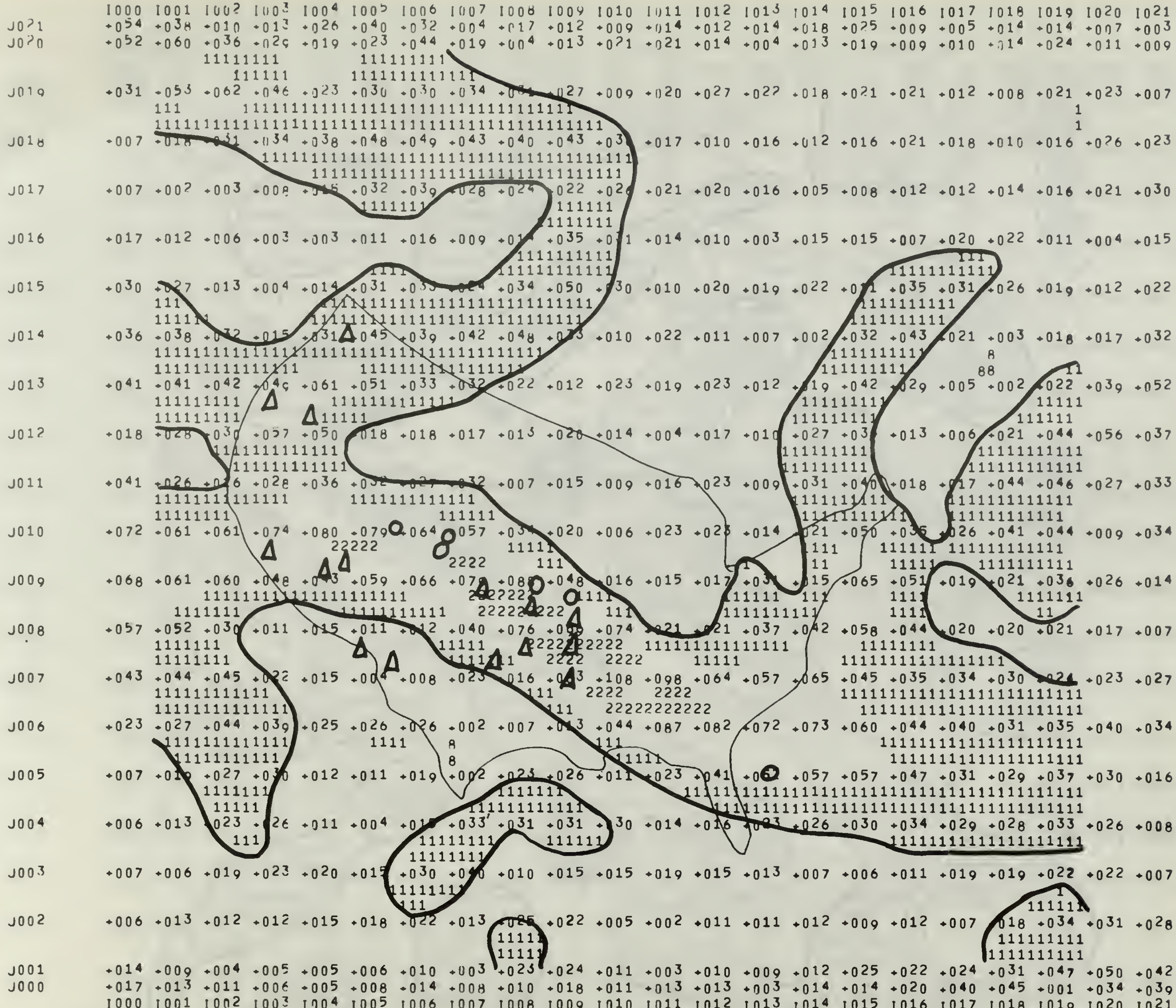
LOWER LEVEL Z FIELD   LAYER 2   PROG.   24 HOURS   12Z 10 MARCH 1965

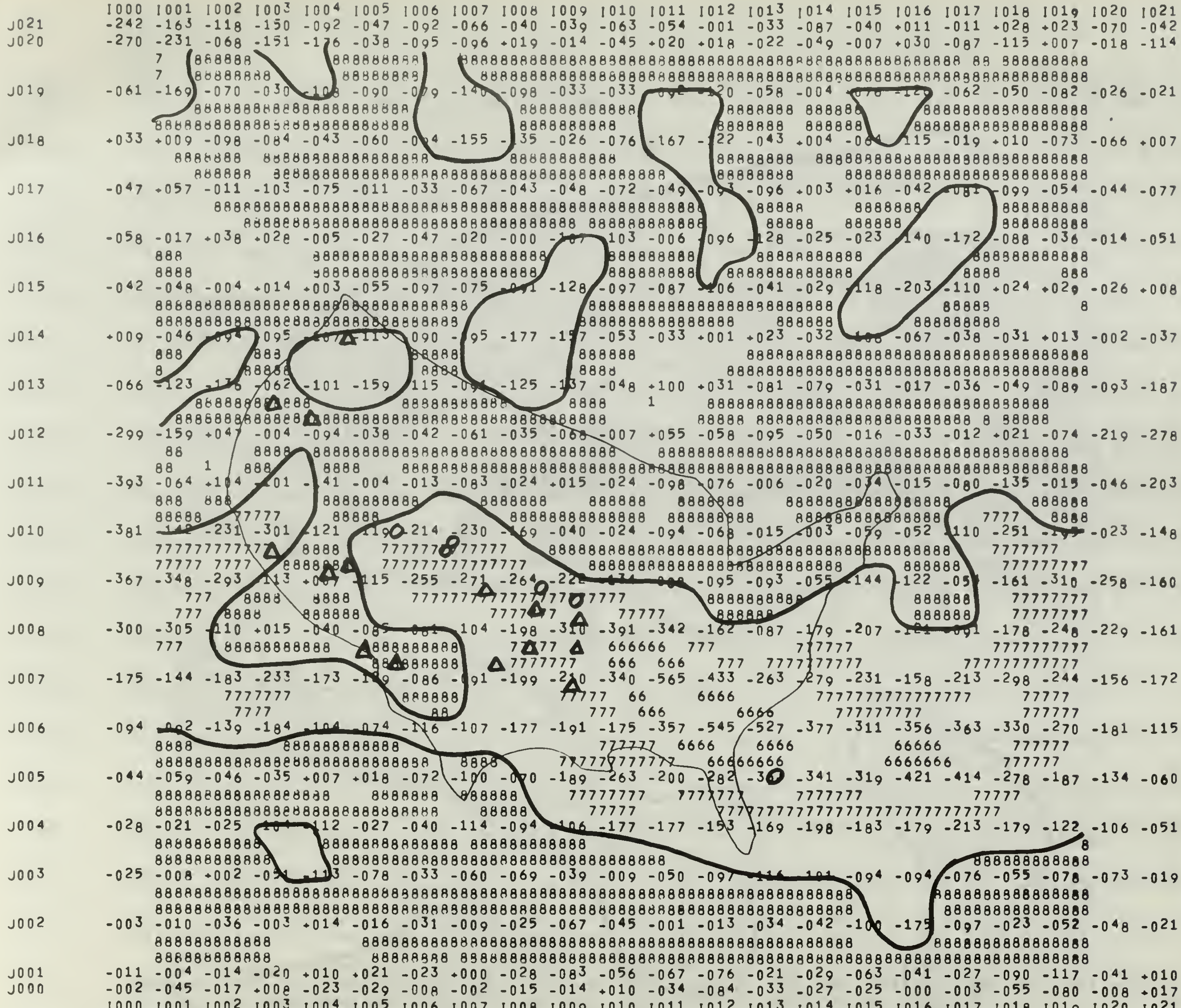


LAPLACIAN OF VORTICITY LAYER 2 PROG. 24 HOURS 12Z 10 MARCH 1965



VERT GRAD OF VT LAYER 2 PROG. 24 HOURS 12Z 10 MARCH 1965

KINETIC ENERGY LAYER 2 PROG. 24 HOURS 12Z 10 MARCH 1965



PROG KAT FIELD LAYER 2 PROG. 24 HOURS 12Z 10 MARCH 1965

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LJ021   +423 +423 +423 +452 +505 +515 +463 +386 +323 +287 +257 +205 +140 +076 +033 +065 +131 +175 +255 +356 +433 +509
LJ020   +516 +502 +526 +572 +613 +622 +564 +491 +439 +368 +313 +274 +187 + 74 +004 +016 +041 +032 +115 +295 +426 +490
             888888       1111111     8888      777    6666666    55   44                            44  55 66  7
             88       111111111111111    8888     777    666666   555  444    33333333               44  55 66  7
 J019   +598 +606 +650 +693 +705 +701 +654 +569 +488 +391 +312 +261 +159 +021 +947 +959 +980 +995 +107 +296 +422 +461
             111111                 1111     888     777    6666     555  44   3333333333333333      44  5  66
             111     222222222        111    888     777    6666    555  44  33333  33333333333     444 55  66
 J018   +657 +703 +762 +798 +792 +762 +694 +582 +480 +391 +309 +228 +094 +950 +902 +938 +971 +010 +139 +301 +388 +409
               2222222    222222222   111   888    7777     6666    55  44  33          3333333     44  55  666
              222222        222222    11    88    7777      6666    55  4  33            33333     44  55  666
 J017   +707 +766 +822 +846 +830 +784 +689 +542 +429 +376 +324 +231 +074 +913 +850 +888 +963 +050 +172 +298 +367 +382
             22222            22222   11  88  7777          6666    55  44  33   222222   333   44   55   6666
             2222           2222222   11  88  777           66666   555  4  33   222222   333  44  555  6666
 J016   +744 +791 +823 +824 +804 +768 +690 +545 +410 +356 +326 +249 +121 +967 +854 +861 +992 +152 +264 +331 +373 +381
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             222222222222222222       111   888  777      666666    555  444  333        33  44  55   66666
 J015   +754 +782 +783 +762 +748 +729 +688 +592 +461 +366 +317 +261 +166 +052 +958 +957 +083 +237 +325 +360 +375 +379
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                                  1111111    88    777    6666666    555    4444444444444    55   666666
 J014   +730 +737 +721 +702 +696 +680 +646 +571 +461 +368 +319 +281 +206 +122 +087 +115 +195 +276 +326 +358 +380 +407
                  11111111111111111111    888    777     666666666      5555            5555    66666666
             1111111111111111111111     888    777    66666666666     55555     555555      666666666
 J013   +675 +656 +638 +633 +634 +621 +574 +474 +372 +327 +312 +300 +258 +192 +175 +215 +259 +288 +314 +343 +386 +451
                                  8888    777    66666666666666666       5555555555        666666666666
                        888888      888888   777    66666666666666666666      55555555         6666666666
 J012   +613 +578 +562 +553 +556 +566 +530 +420 +328 +309 +309 +304 +283 +235 +210 +230 +255 +273 +303 +341 +396 +480
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             8888888888888888888888888888    7777      6666666666666666666          55555          6666666     7
 J011   +581 +541 +522 +517 +530 +551 +534 +458 +384 +359 +353 +334 +295 +246 +215 +221 +241 +268 +315 +371 +433 +513
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             8888     8888888888888888888      777777777        6666       555555        66666     77777
 J010   +590 +546 +520 +539 +579 +589 +564 +522 +471 +431 +416 +387 +313 +242 +218 +224 +244 +291 +358 +426 +493 +568
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             88888888888              88888888       77777777     666         55555       6666    7777    8
 J009   +625 +583 +568 +594 +632 +638 +613 +582 +543 +493 +458 +423 +342 +252 +220 +231 +269 +340 +419 +494 +569 +642
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                      1111111111111111              888888     77777   666           6666   7777   8888
 J008   +671 +640 +641 +657 +666 +669 +667 +649 +614 +565 +512 +465 +403 +311 +252 +273 +349 +435 +501 +563 +643 +718
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             111111111111111111111111111 11111111111    888888     7777    66666666   777   8888888    11
 J007   +718 +697 +700 +710 +707 +708 +717 +710 +683 +639 +590 +543 +488 +414 +353 +378 +469 +546 +587 +629 +701 +770
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                                                1111111        888888      77777     8888      1111111
 J006   +755 +743 +746 +755 +757 +757 +761 +763 +743 +705 +672 +634 +588 +542 +504 +519 +583 +633 +660 +699 +757 +807
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             2222222222222222222222222222222222222222222      111111111                 111111111      222
 J005   +782 +777 +784 +795 +802 +795 +789 +799 +796 +773 +747 +718 +691 +666 +644 +648 +679 +707 +729 +765 +808 +839
             2222222222222222222222222222222222222222222222222         11111111111111              22222222
             22222222222        2222222222222        22222222222222                           22222222222
 J004   +802 +801 +811 +824 +833 +825 +814 +826 +838 +831 +813 +793 +775 +758 +743 +740 +754 +776 +795 +816 +842 +861
             2222222                                          2222222222222222222222222222222222222222
             22222                                               2222222222222222222222222222222
 J003   +816 +817 +827 +840 +847 +845 +846 +858 +868 +867 +859 +846 +831 +818 +806 +798 +807 +827 +842 +852 +863 +872
                                                                            222222222
                                              33333333
 J002   +826 +828 +837 +851 +856 +857 +867 +881 +886 +886 +881 +872 +863 +853 +841 +837 +846 +858 +865 +870 +868 +865
                                          333333333333333333333
                                         33333333333333333333333
 J001   +833 +836 +844 +856 +864 +869 +878 +888 +893 +894 +888 +877 +867 +867 +862 +861 +868 +874 +876 +875 +863 +850
LJ000   +837 +840 +847 +857 +866 +874 +882 +889 +893 +894 +887 +872 +865 +870 +872 +872 +876 +880 +879 +874 +861 +852
L       I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M     LOWER LEVEL Z FIELD     LAYER 1          PROG.       24 HOURS        00Z 11 MARCH 1965
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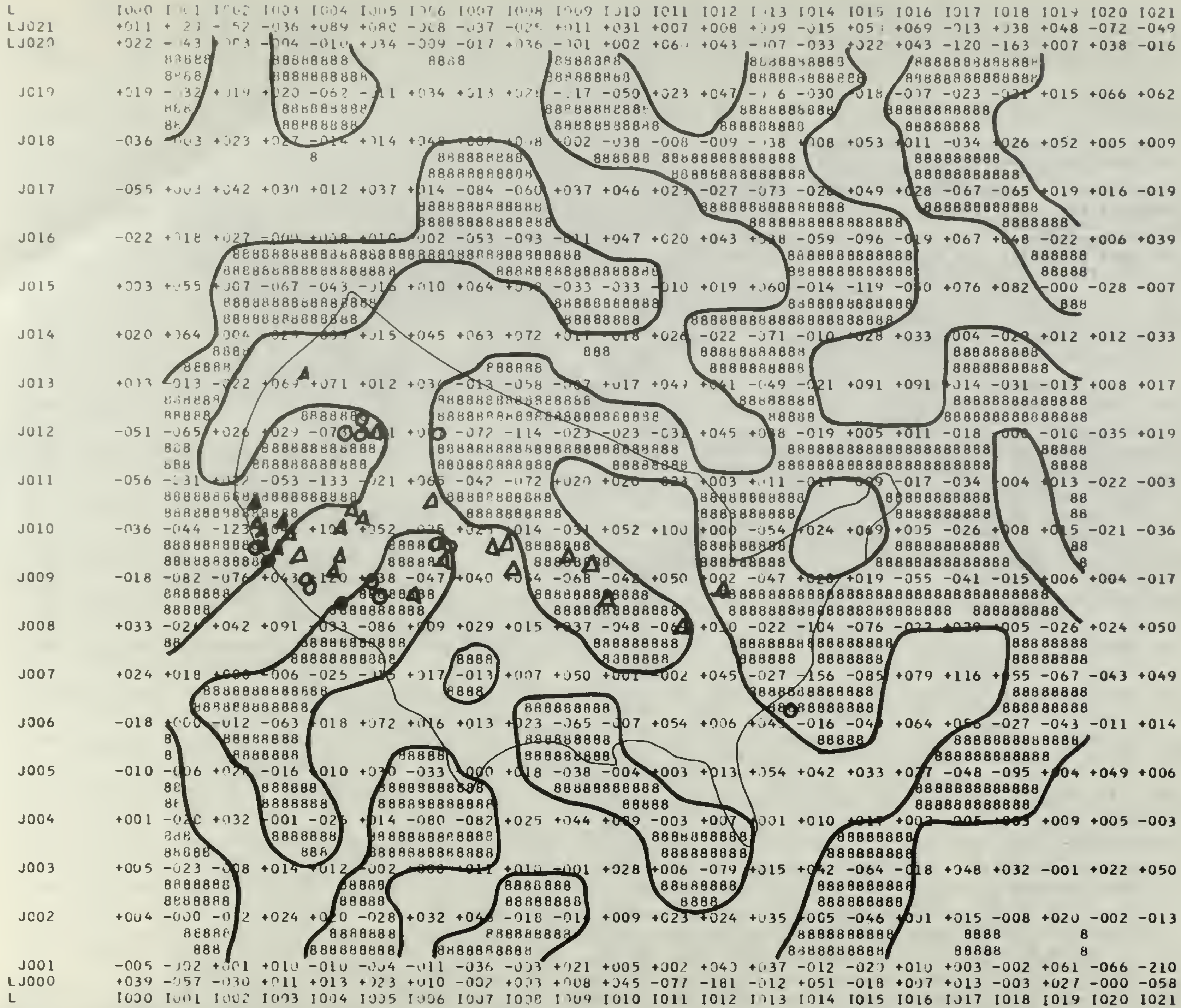
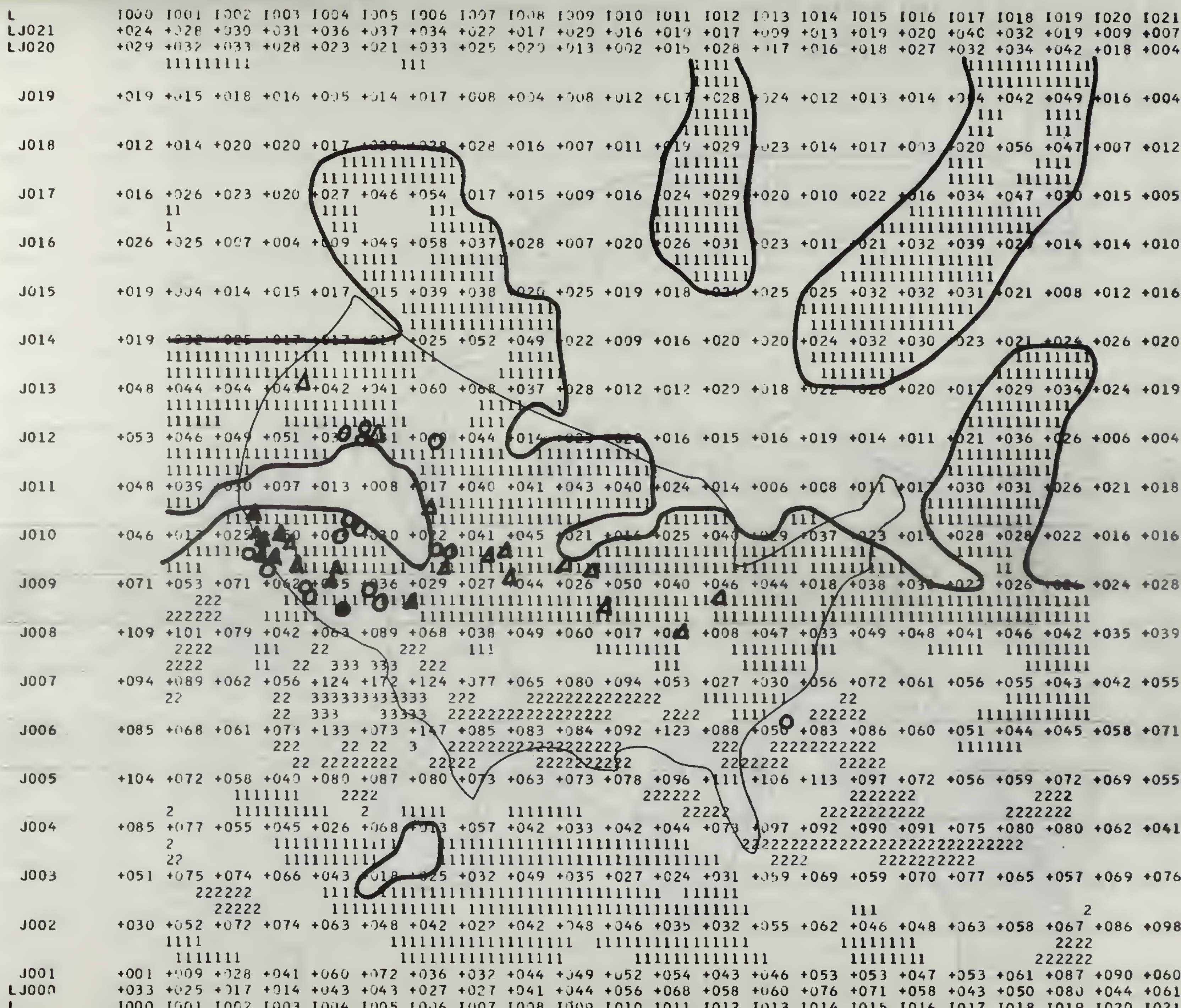
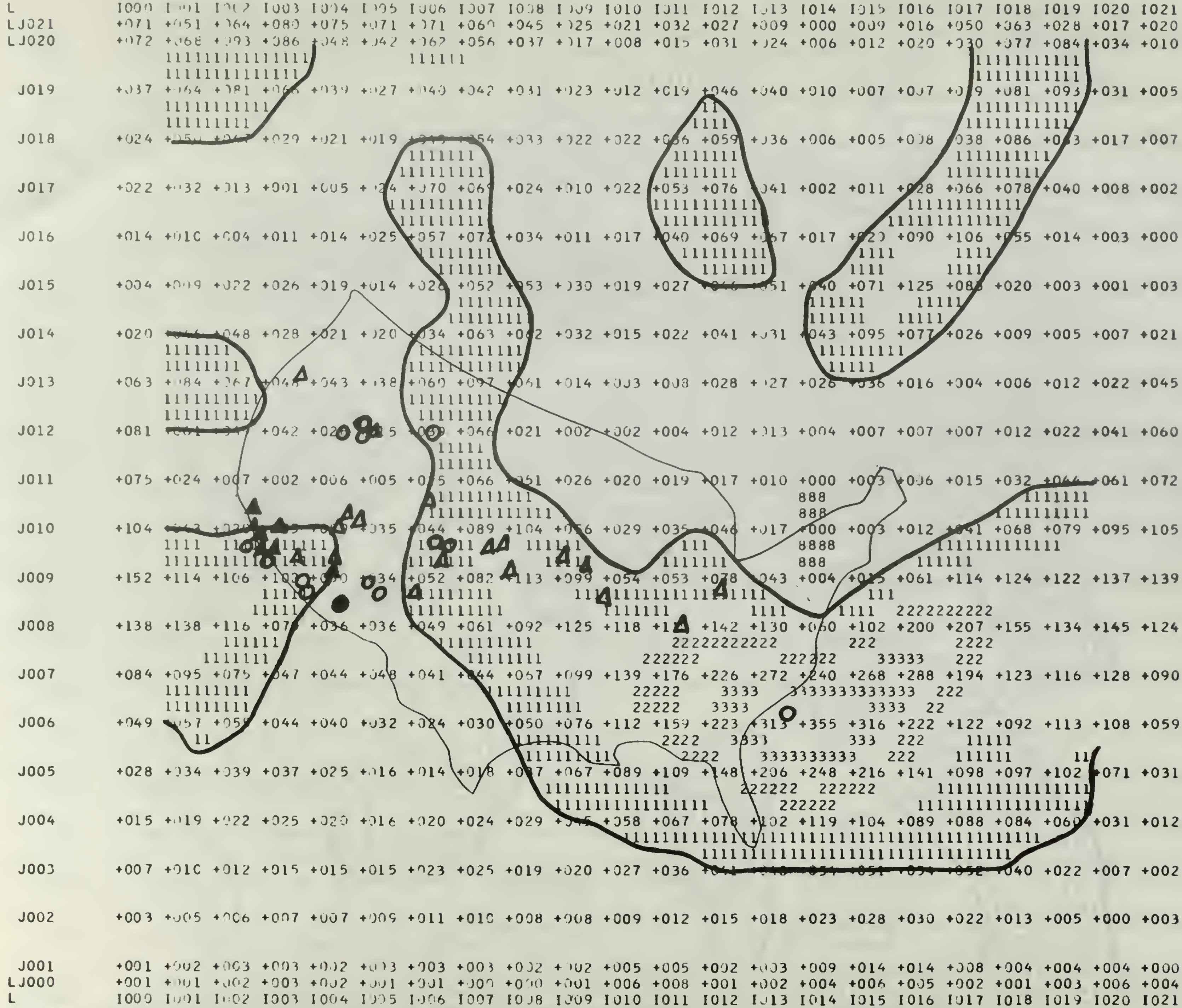


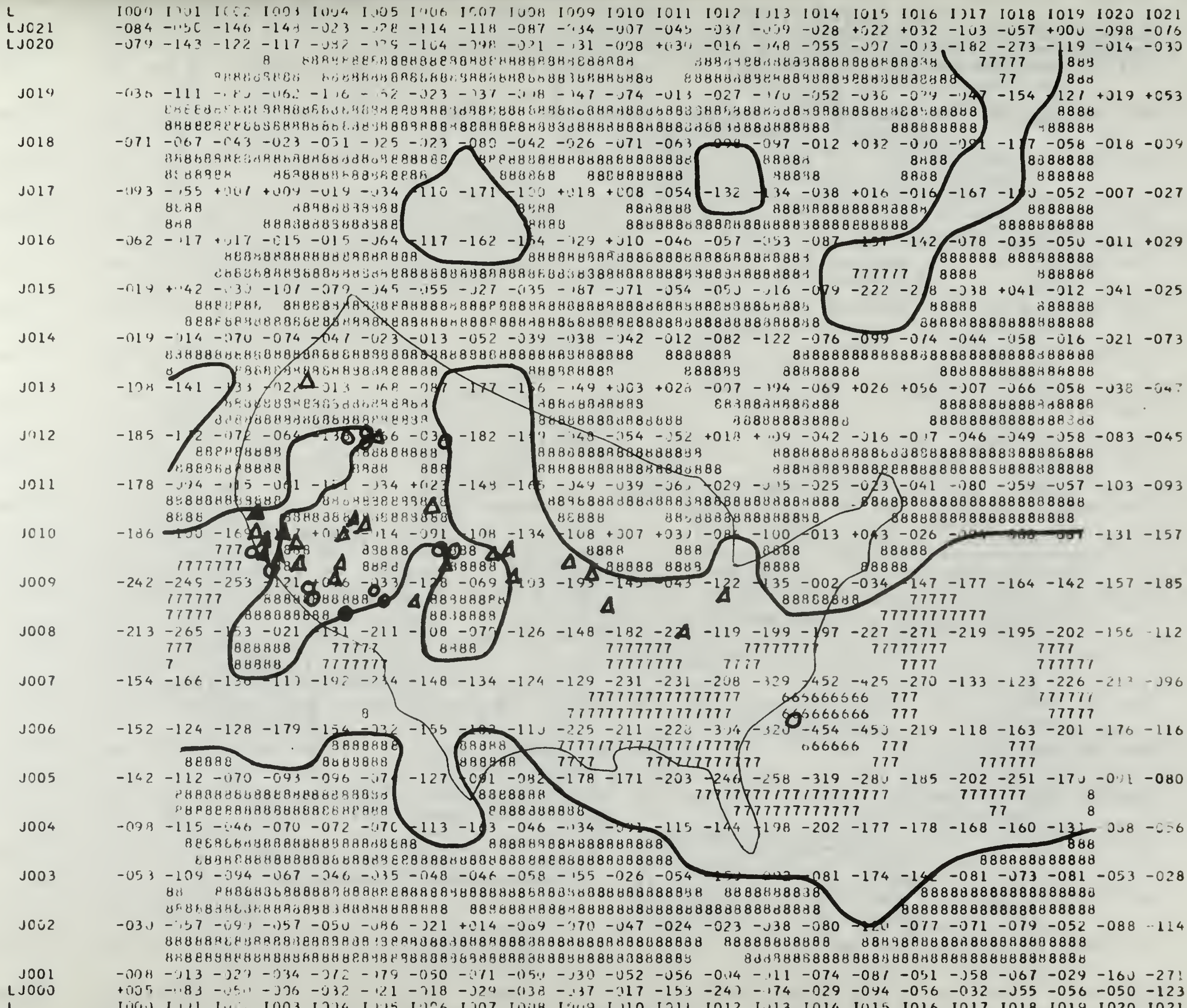
LAPLACIAN OF VORTICITY LAYER 1 PROG. 24 HOURS 00Z 11 MARCH 1965



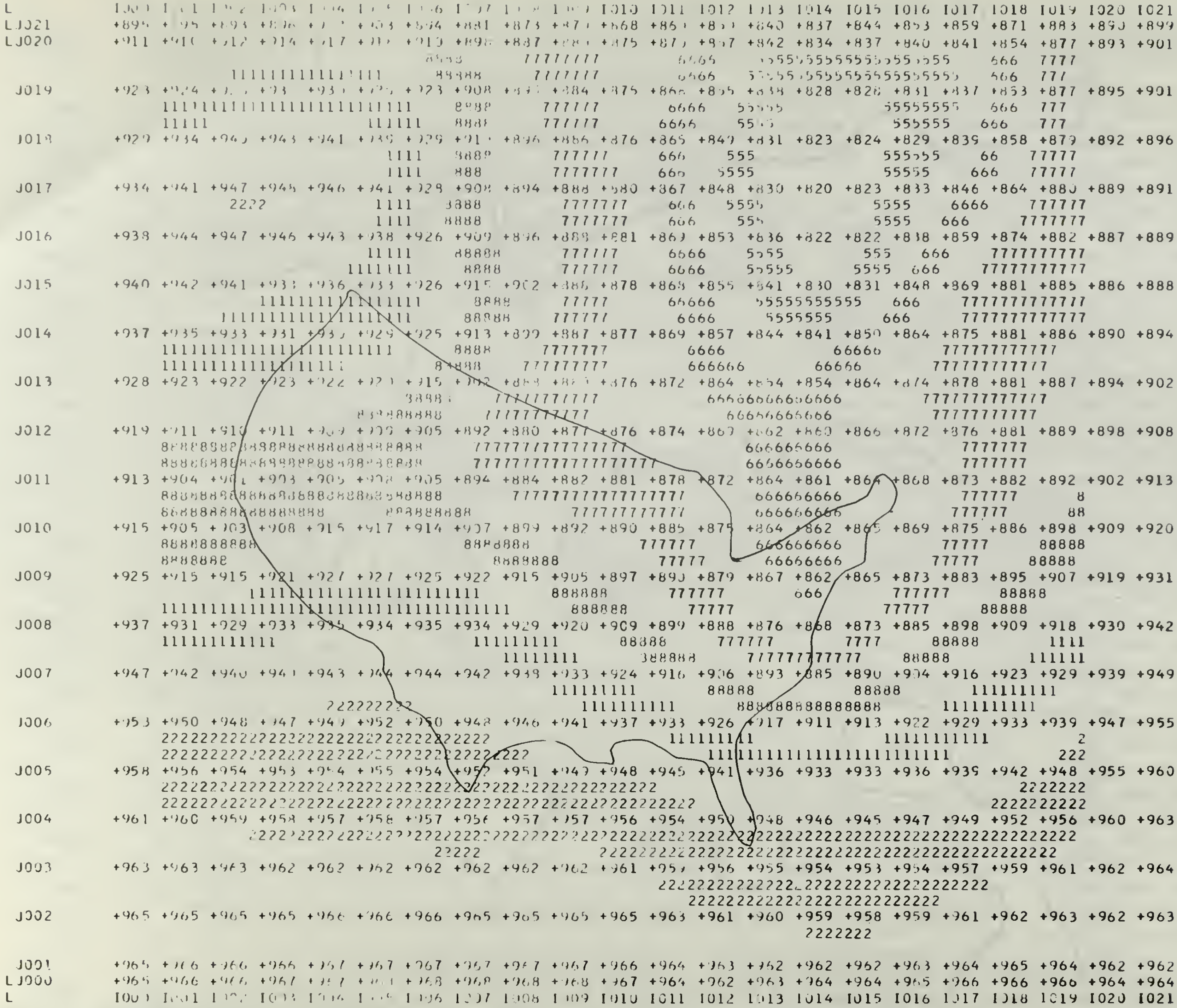
VERT GRAD CF VT LAYER 1 PROG. 24 HOURS 00Z 11 MARCH 1965



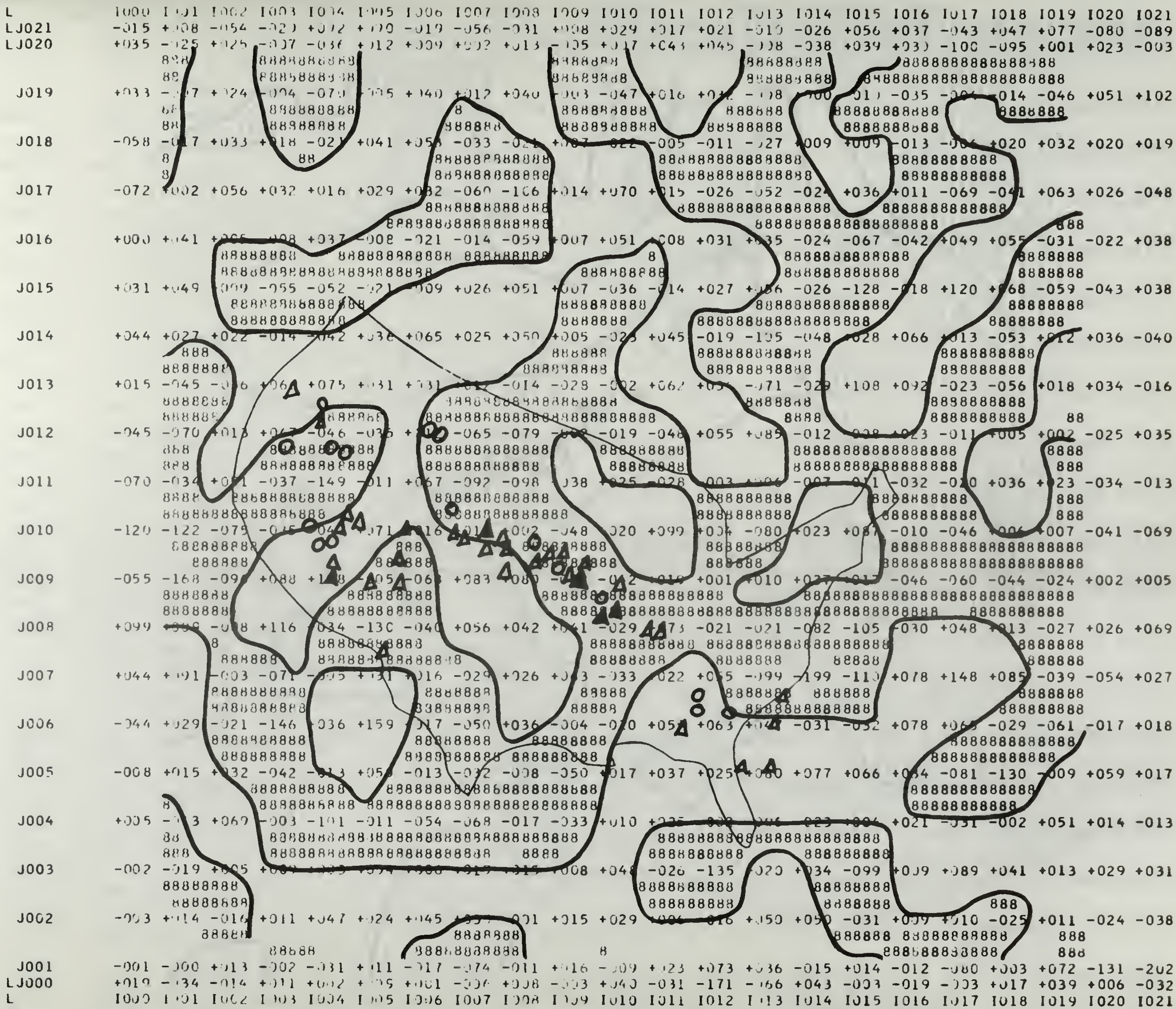
KINETIC ENERGY LAYER 1 PROG. 24 HOURS 00Z 11 MARCH 1965



PROG KAT FIELD LAYER 1 PROG. 24 HOURS 00Z 11 MARCH 1965



LOWER LEVEL Z FIELD LAYER 2 PROG. 24 HOURS 00Z 11 MARCH 1965



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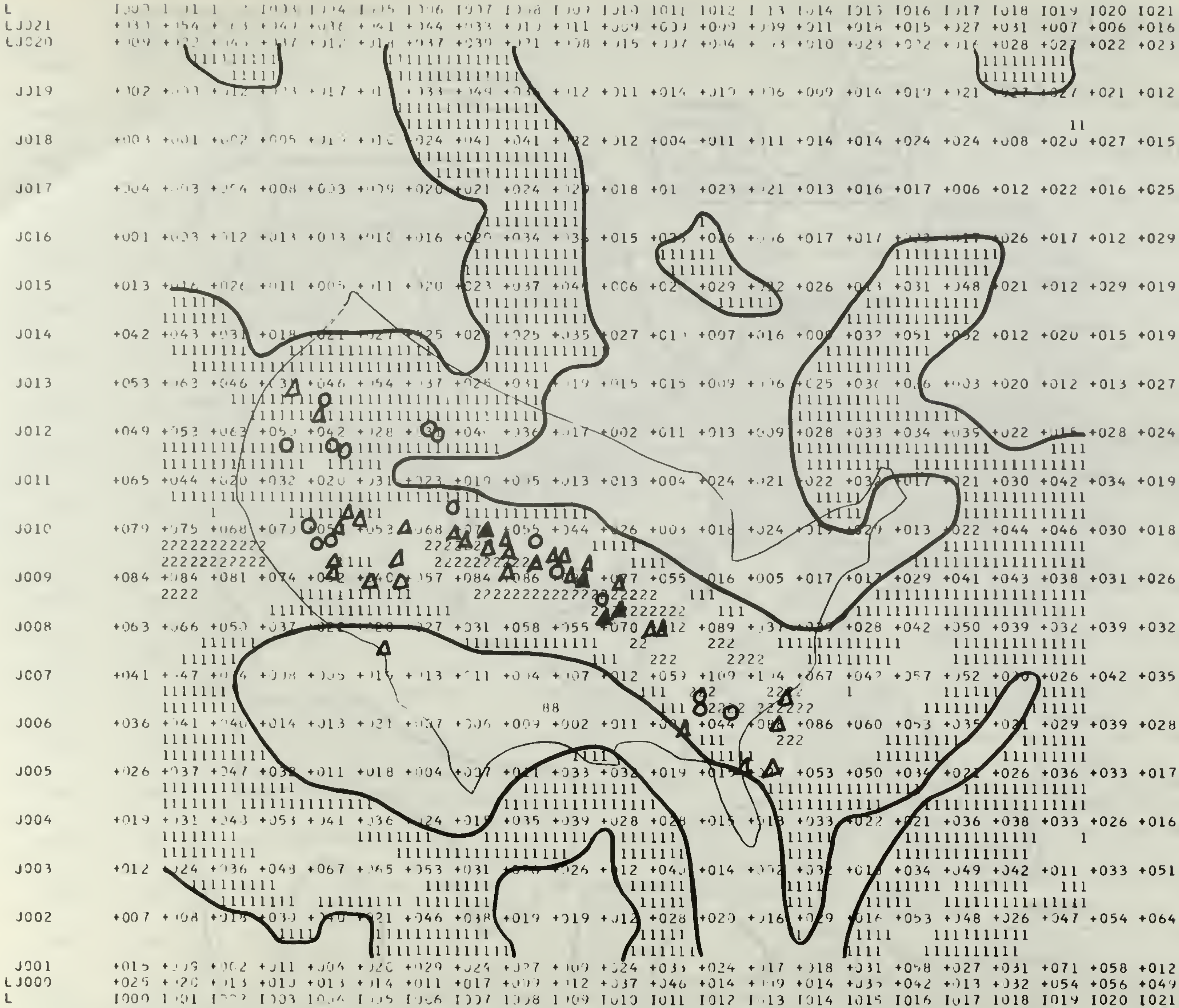
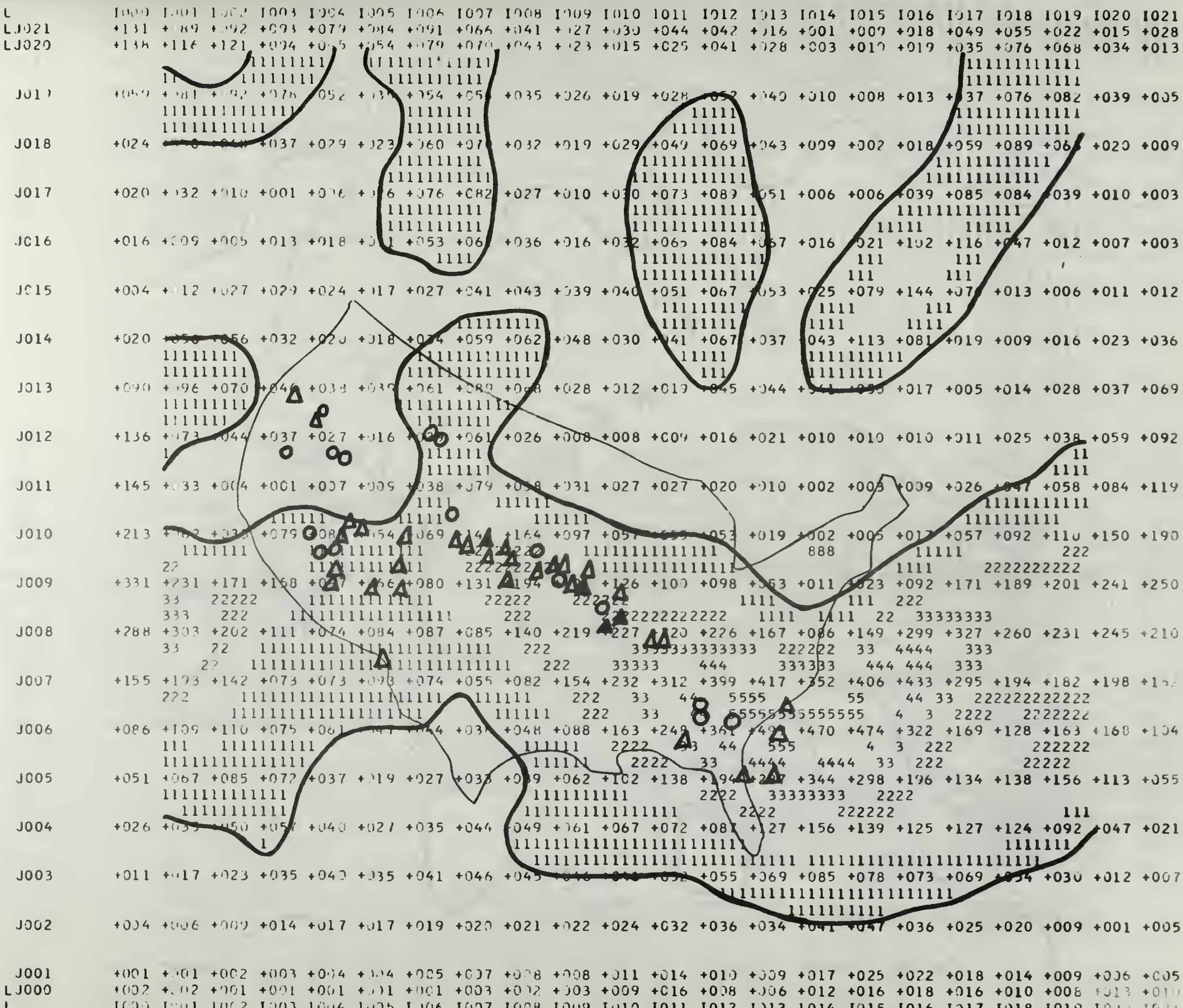


VERT GRAD OF VT LAYER 2 PROG. 24 HOURS 00Z 11 MARCH 1965



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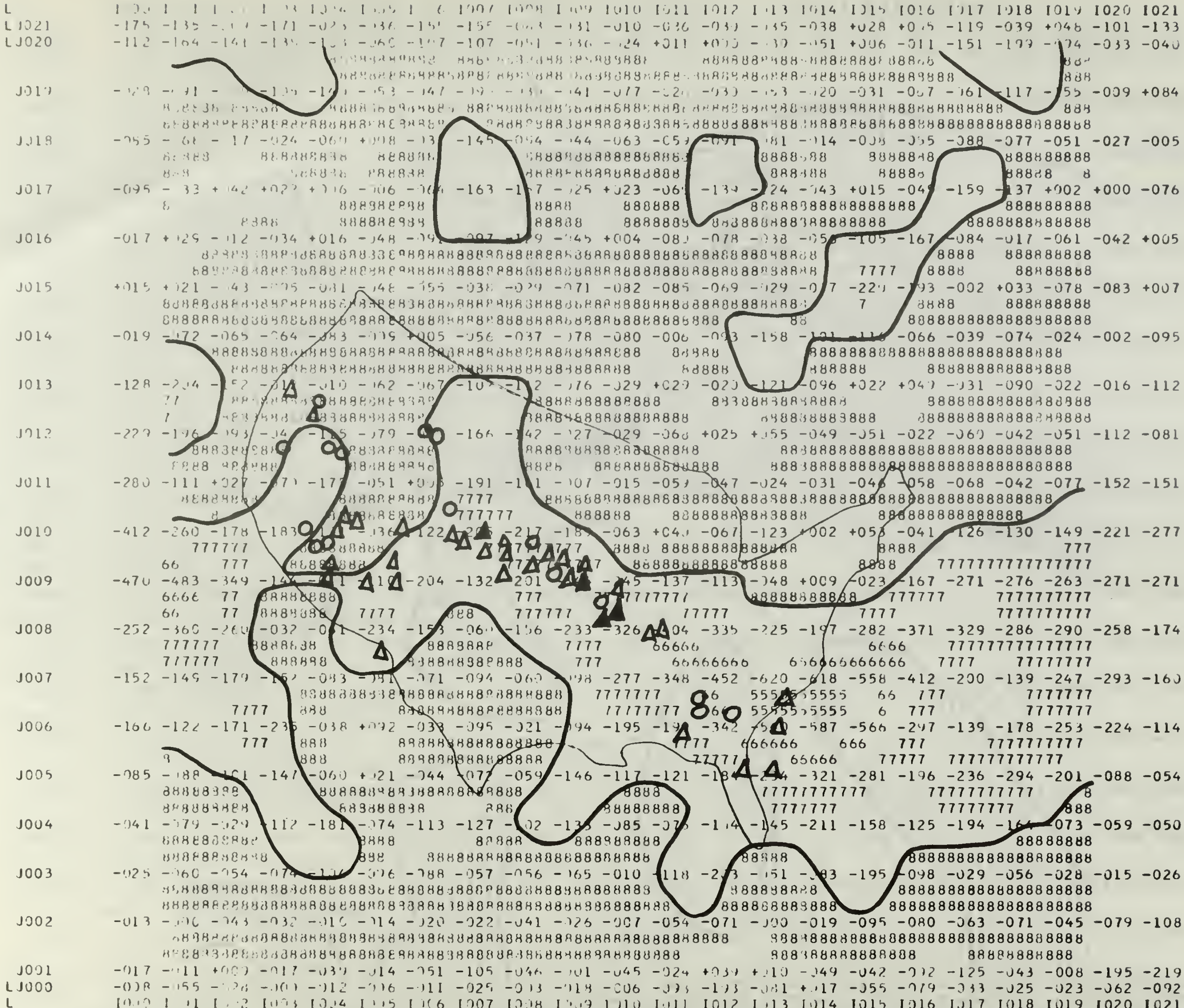

PROG KAT FIELD LAYER 2 PROG. 24 HOURS 00Z 11 MARCH 1965

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LJ021         +407 +415 +408 +393 +406 +464 +488 +417 +304 +225 +193 +153 +114 +050 +996 +999 +027 +089 +215 +340 +437 +522
LJ020         +504 +509 +499 +513 +561 +578 +596 +536 +473 +321 +256 +225 +163 +073 +990 +973 +991 +027 +147 +320 +436 +484
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                   888883         111111111111         888   77    66666        555    444      33333333333       44  55 66    7
  J019        +586 +601 +615 +640 +697 +707 +574 +615 +512 +383 +302 +253 +168 +154 +974 +956 +970 +022 +152 +320 +429 +448
                      11111111                  11111   888  77    66666       555    44      3333333333333      44   55   66    7
                   1111111                      1111   888  777    666      555    44      33333333333333      44   55   66
  J018        +633 +667 +710 +739 +758 +758 +716 +636 +531 +410 +306 +228 +118 +996 +944 +938 +957 +047 +194 +320 +388 +408
                   11           222222222         111   888   777    666    555   444   33333        333333   444   55   6666
                         2222222222222222         111   88   777    666    55   44   333              333   44   55   6666
  J017        +686 +725 +767 +776 +768 +763 +716 +611 +498 +397 +300 +200 +067 +934 +868 +878 +968 +116 +253 +325 +351 +368
                      2222222222222222        111   888    777     6666  555   44   333     222222     333 44   55     6666666
                     2222222222222          111   888    777     6666   55   44   33    2222222   33   44   55   6666666
  J016        +734 +758 +777 +779 +748 +734 +675 +550 +447 +378 +301 +204 +075 +939 +844 +856 +001 +177 +290 +336 +350 +358
                    222222222                111   888    7777        6666    555   44    33          33   44   55     6666666
                                         111   888    7777        66666    55    44    3333        33   44   555     6666666
  J015        +745 +747 +745 +734 +727 +701 +604 +478 +409 +367 +315 +241 +128 +026 +964 +965 +064 +199 +287 +330 +352 +370
                                         1111    88    77777          666666    555    4444               4444   555      66666666
                                         1111    88    777777         6666666    555    4444444444444    5555      66666666
  J014        +721 +705 +697 +694 +697 +659 +552 +457 +407 +356 +316 +281 +203 +124 +098 +110 +153 +227 +290 +324 +349 +378
                   111111111111111111111    888     77777       6666666666      5555               55555      6666666666
                   1111111111111111111    8888     7777     666666666666      5555           55555555      6666666666
  J013        +677 +643 +623 +626 +633 +608 +548 +408 +418 +329 +287 +292 +257 +184 +158 +176 +203 +249 +290 +318 +353 +396
                                         888888      777    66666    66666        5555555555555555555      66666666666
                      88888888888       88888888      777    666                  555555555555555555       666666666
  J012        +628 +584 +548 +539 +558 +566 +544 +494 +398 +292 +255 +272 +258 +210 +184 +187 +211 +256 +285 +307 +371 +454
                   888888888888888888888888888      777    666                         5555555555555555      666666666
                   88888             8888888888888      77    6666                         55555555555555      666666666
  J011        +595 +541 +504 +497 +522 +541 +534 +476 +371 +297 +277 +274 +272 +243 +204 +195 +217 +263 +306 +342 +419 +523
                   88               8888888888888      77     66666666666666666666            5555555555      666666      77
                   8                8888888888888      777      66666666666666666666           5555555555      6666      7777
  J010        +594 +529 +485 +496 +537 +557 +554 +505 +418 +373 +356 +344 +344 +302 +232 +202 +214 +263 +340 +416 +489 +575
                   88             888888888888888888      7777777                       6666      55555555      6666    7777
                   888            888888888      8888888      77777777777777              6666      555555      666    777
  J009        +624 +562 +517 +516 +555 +589 +600 +582 +533 +481 +446 +430 +412 +353 +272 +224 +231 +290 +375 +465 +544 +623
                   8888888888888888888                  888888        7777777777     6666           66666    777     88
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  J008        +670 +618 +580 +564 +576 +614 +646 +653 +625 +576 +530 +491 +454 +398 +331 +297 +308 +355 +425 +506 +590 +670
                                          11111111111111          8888888        77777        66666666       77777    8888
                   11                   11111111111111111111          8888888        777777               7777     888
  J007        +714 +669 +634 +625 +637 +667 +698 +705 +686 +657 +618 +571 +529 +478 +427 +408 +408 +424 +483 +570 +652 +719
                   11111111111111111111111                     111111111       888888     777777777777777      8888    11
                    111111111111111111                     111111111       888888                        888     111
  J006        +749 +716 +688 +684 +705 +733 +751 +758 +755 +738 +710 +678 +635 +583 +545 +523 +507 +510 +559 +645 +721 +773
                                            2222222222222222222             111111        8888888888888888888     1111
                                        2222222222222222222222222222           1111111              8888       1111
  J005        +776 +755 +739 +737 +753 +776 +796 +820 +817 +809 +790 +765 +726 +687 +659 +634 +617 +622 +658 +718 +777 +817
                   22             222222222222222              22222222222          11111111111111111111111     222
                   2222222222222222222222222222                     222222222              1111111111     22222
  J004        +796 +782 +772 +776 +788 +808 +831 +850 +858 +856 +846 +825 +798 +774 +752 +732 +719 +723 +747 +783 +819 +845
                   2222222222222222222222                              2222222222222222             22222222222
                   2222222222222222222                                     22222222222222222222222222222222
  J003        +811 +801 +796 +801 +814 +833 +856 +874 +882 +883 +877 +864 +847 +831 +815 +803 +795 +796 +808 +828 +848 +862
                   22222222222222                    333333333333333                  22222222222222
                   222222222222                    3333333333333333333
  J002        +820 +815 +813 +819 +831 +845 +869 +884 +893 +895 +891 +881 +866 +853 +848 +845 +841 +841 +846 +855 +862 +866
                   22222222                      33333333333333333333333
                                                 33333333333333333333333
  J001        +827 +824 +824 +831 +842 +856 +872 +886 +895 +897 +893 +881 +864 +856 +862 +866 +863 +863 +864 +866 +864 +863
LJ000         +831 +831 +832 +838 +847 +855 +871 +882 +890 +892 +887 +874 +862 +863 +870 +873 +871 +869 +868 +868 +865 +865
L        1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021
P        LOWER LEVEL Z FIELD    LAYER 1          PROG.      24 HOURS        12Z 11 MARCH 1965
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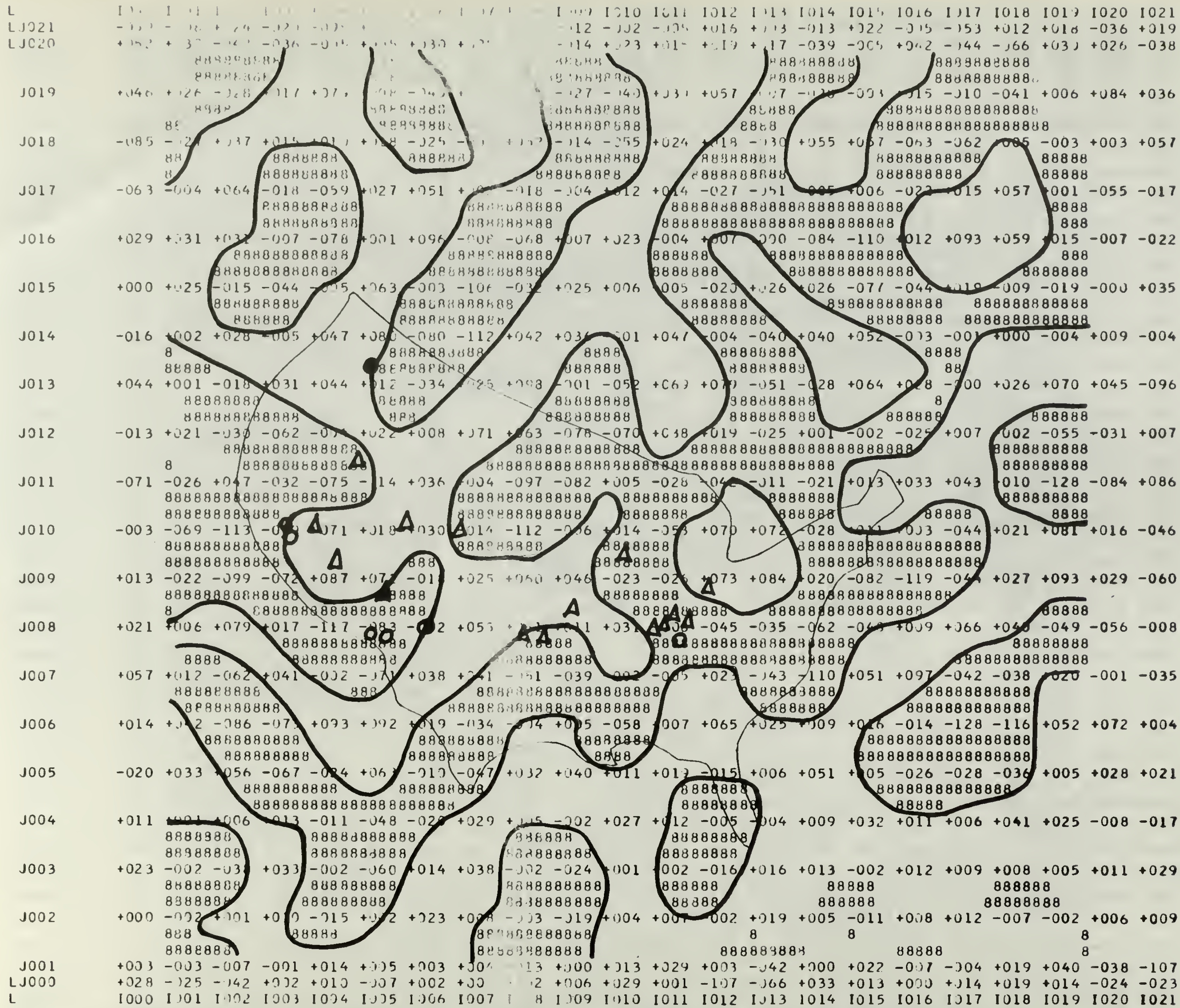
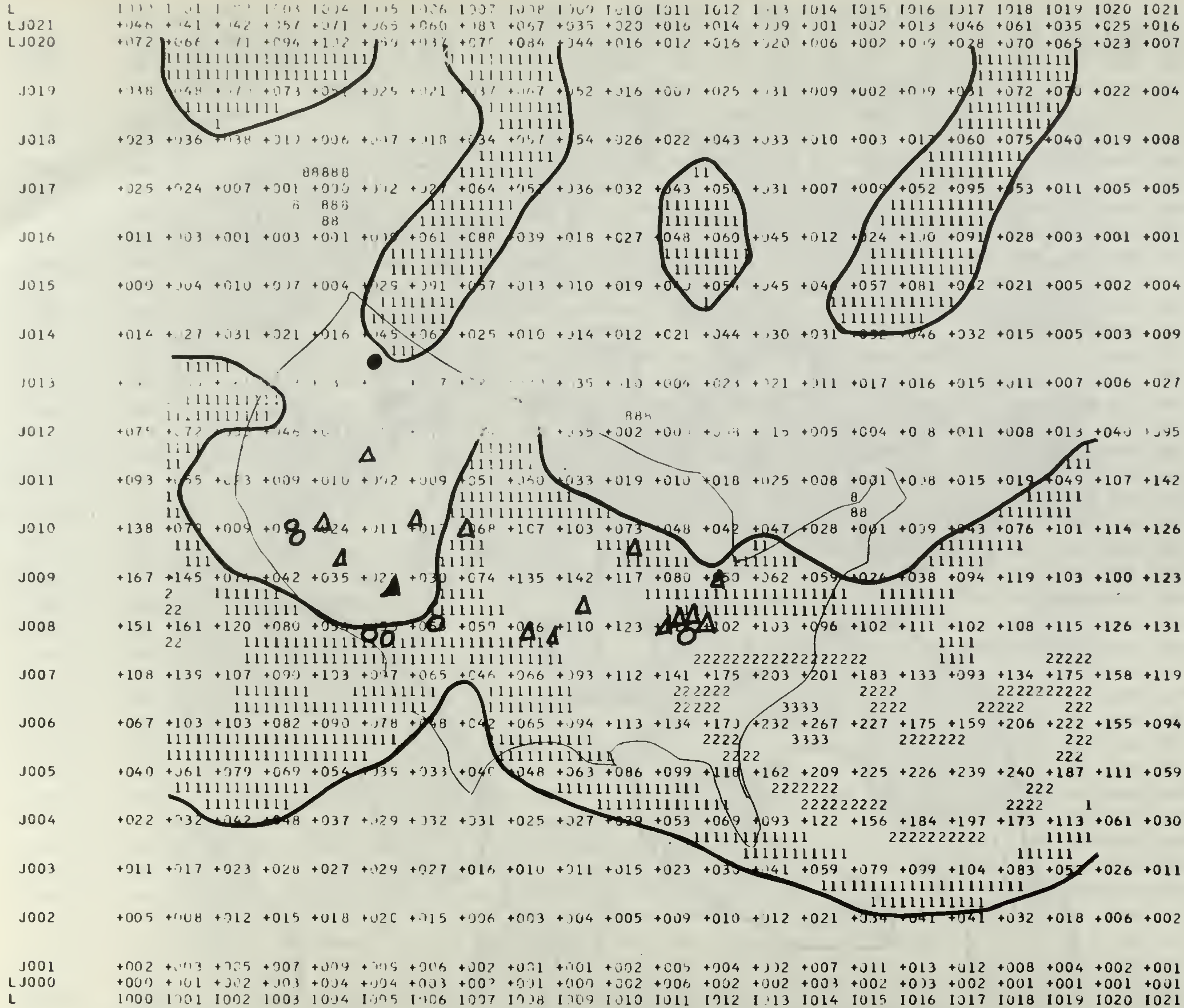
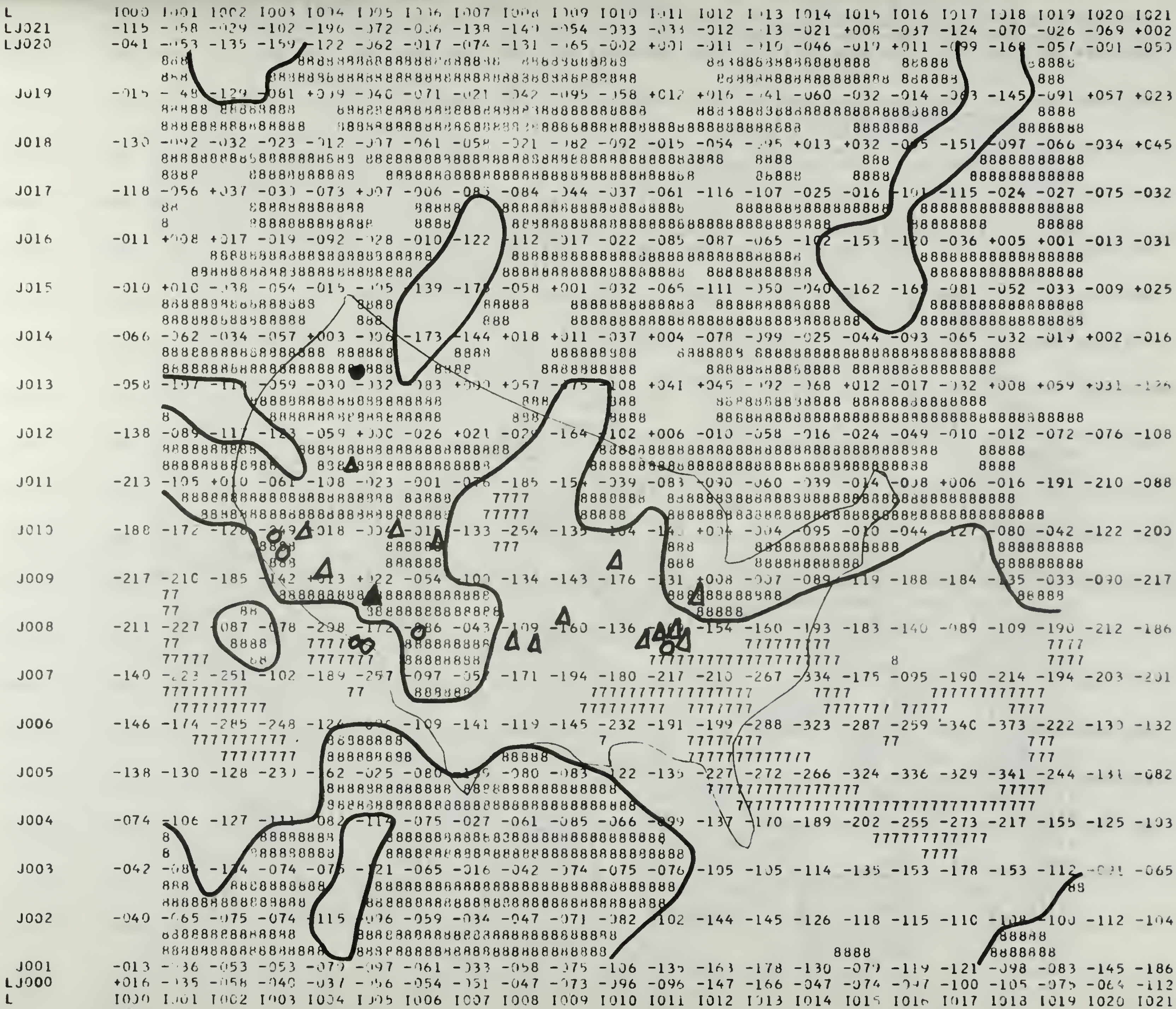


LAPLACIAN OF VORTICITY LAYER 1 24 HOURS 12Z 11 MARCH 1965


VERT GRAD OF VT LAYER 1 PROG. 24 HOURS 12Z 11 MARCH 1965



M KINETIC ENERGY LAYER 1 PROG. 24 HOURS 12Z 11 MARCH 1965



PROG KAT FIELD LAYER 1 PROG. 24 HOURS 12Z 11 MARCH 1965

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L      I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
LJ021  +888 +888 +887 +885 +8[illegible] +[illegible]7 +899 +8[illegible] +9[illegible] +860 +854 +851 +847 +841 +835 +836 +842 +854 +870 +884 +894 +904
LJ020  +903 +903 +902 +903 +907 +913 +914 +905 +[illegible] +872 +863 +86 +854 +843 +833 +832 +838 +846 +862 +882 +895 +901
            888888888888                 888    77        666666666    555555555555555    666   7777
            88                           88     777       66666666     555555555555555    666   777
 J019  +915 +916 +916 +921 +924 +927 +924 +9[illegible] +9[illegible] +881 +868 +864 +855 +842 +831 +828 +832 +842 +859 +879 +894 +898
                 11111111111111111     888   777     666666    55555     555555   666   7777
            1111111111111111111111111  8888  7777    666666    55555     55555    6666  7777
 J018  +922 +925 +930 +932 +934 +935 +930 +92[illegible] +915 +885 +870 +863 +851 +836 +828 +825 +828 +843 +862 +878 +889 +894
            111111111111111111  1111111   888   7777   66666   55555    5555   666   77777
            11111111111111111   1111111   8888  7777   6666    5555     5555   666   777777
 J017  +929 +933 +936 +934 +934 +937 +932 +917 +9[illegible] +886 +874 +862 +845 +830 +822 +822 +833 +853 +871 +880 +884 +887
            11          11111111111 1111111   888   777777   6666   5555     5555  666  77777777
                        1111111111111111111   888   777777   6666   5555     555   666  777777777
 J016  +935 +938 +937 +934 +932 +934 +926 +90[illegible] +902 +885 +876 +863 +847 +832 +822 +823 +839 +862 +877 +882 +884 +885
                     1111111111111111   888   7777777   6666   55555   555   666   7777777777
                   11111111111111111   8888   77777777  6666   555555  5555  666   7777777777
 J015  +937 +937 +935 +932 +931 +929 +916 +9[illegible] +890 +885 +877 +866 +852 +840 +832 +832 +845 +864 +877 +882 +885 +888
             1111111111111111111111   888   77777777   6666   5555555555   666   7777777777
            11111111111111111111111   8888  7777777    6666   55555   66666   7777777777
 J014  +936 +933 +930 +928 +928 +924 +909 +896 +892 +886 +877 +87[illegible] +858 +846 +843 +847 +856 +868 +878 +884 +887 +889
            1111111111111111111   88888   777777   66666   6666666   77777777777
            11111                 88888   777777   66666   66666666  77777777777
 J013  +931 +925 +920 +918 +92[illegible] +917 +908 [illegible] +[illegible]3 +882 +873 +871 +863 +852 +851 +857 +864 +871 +879 +885 +888 +891
                               88888   7777   66666666666666666666   77777777777
                   8888 8888   888888  7777   66666666666666666666   77777777777
 J012  +923 +914 +908 +906 +909 +911 +907 +9[illegible] +889 +875 +869 +869 +865 +858 +857 +860 +865 +870 +877 +882 +889 +899
            8888888888888888888888888888   77777   66666666666666666   7777777777
            888888888888888888888888888    7777    6666666666666666    777777777
 J011  +918 +906 +90[illegible] +897 +903 +908 +9[illegible]8 [illegible] [illegible] +876 +872 +870 +869 +865 +861 +861 +865 +871 +877 +883 +894 +910
            888        888888888888888888   777777   66666666666   7777777
            888        888888888888888888   7777777777   66666666666   777777
 J010  +920 +906 +893 +898 +905 +911 +912 +906 +896 +888 +882 +879 +879 +875 +865 +861 +863 +871 +884 +896 +906 +919
            88888   88888888   88888888   777777777777777   666666666   7777   8888
            888888888888888888   88888888   77777777777   66666666   7777   88888
 J009  +927 +914 +905 +904 +910 +916 +919 +918 +914 +907 +899 +892 +889 +882 +871 +863 +865 +876 +891 +905 +916 +927
              888888888888   88888888   777777   77777   88888
                 88888   111111111   888888888   77777   77777   88888
 J008  +936 +926 +918 +915 +917 +921 +927 +931 +927 +922 +916 +908 +900 +889 +878 +874 +877 +886 +898 +911 +922 +934
            1111   11111111111111111111111   888888   77777777777777777   88888
            1111111   11111111111111   111111111111   88888   7777777777   8888   1
 J007  +944 +936 +929 +927 +929 +932 +938 +934 +937 +933 +928 +924 +916 +905 +895 +893 +893 +895 +905 +919 +931 +941
              1111111111111111   1111111111111   8888888   88888   1111
                111111111   11111111111   888888888888888888888   11111
 J006  +950 +945 +939 +937 +940 +944 +946 +947 +946 +944 +940 +937 +933 +925 +916 +911 +907 +906 +914 +929 +941 +949
                        22222222222222   11111111   8888   11111
            22        222222222222222222222222222   111111111   11111
 J005  +955 +952 +948 +945 +947 +950 +952 +953 +955 +954 +952 +949 +945 +940 +935 +929 +924 +924 +929 +940 +949 +956
            22222222   2222222222222222222222222222222222222   1111111111111111   22
            222222222222222222222222222222222222222222222222222222222   1111111   2222
 J004  +959 +957 +954 +952 +953 +954 +957 +959 +961 +960 +959 +957 +954 +951 +947 +944 +941 +940 +944 +950 +956 +960
            2222222222222222222222222222   222222222222222222222   222222222
            2222222222222222222222222     222222222222222222222222222222222222222222222
 J003  +961 +960 +959 +958 +958 +958 +961 +964 +964 +964 +963 +962 +959 +957 +956 +954 +952 +952 +954 +957 +960 +963
              2222222222222222   22222222222222222222222222222222222
                                 2222222222222222222222222
 J002  +963 +962 +962 +962 +962 +963 +965 +966 +967 +966 +966 +965 +963 +962 +961 +960 +960 +960 +960 +962 +963 +964

 J001  +964 +964 +963 +964 +964 +965 +967 +968 +968 +968 +968 +966 +965 +964 +964 +964 +964 +964 +964 +964 +964 +964
LJ000  +964 +964 +964 +965 +966 +966 +967 +968 +969 +969 +968 +967 +965 +965 +966 +966 +966 +966 +966 +966 +965 +965
L      I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M     LOWER LEVEL Z FIELD    LAYER 2        PROG.     24 HOURS        12Z 11 MARCH 1965
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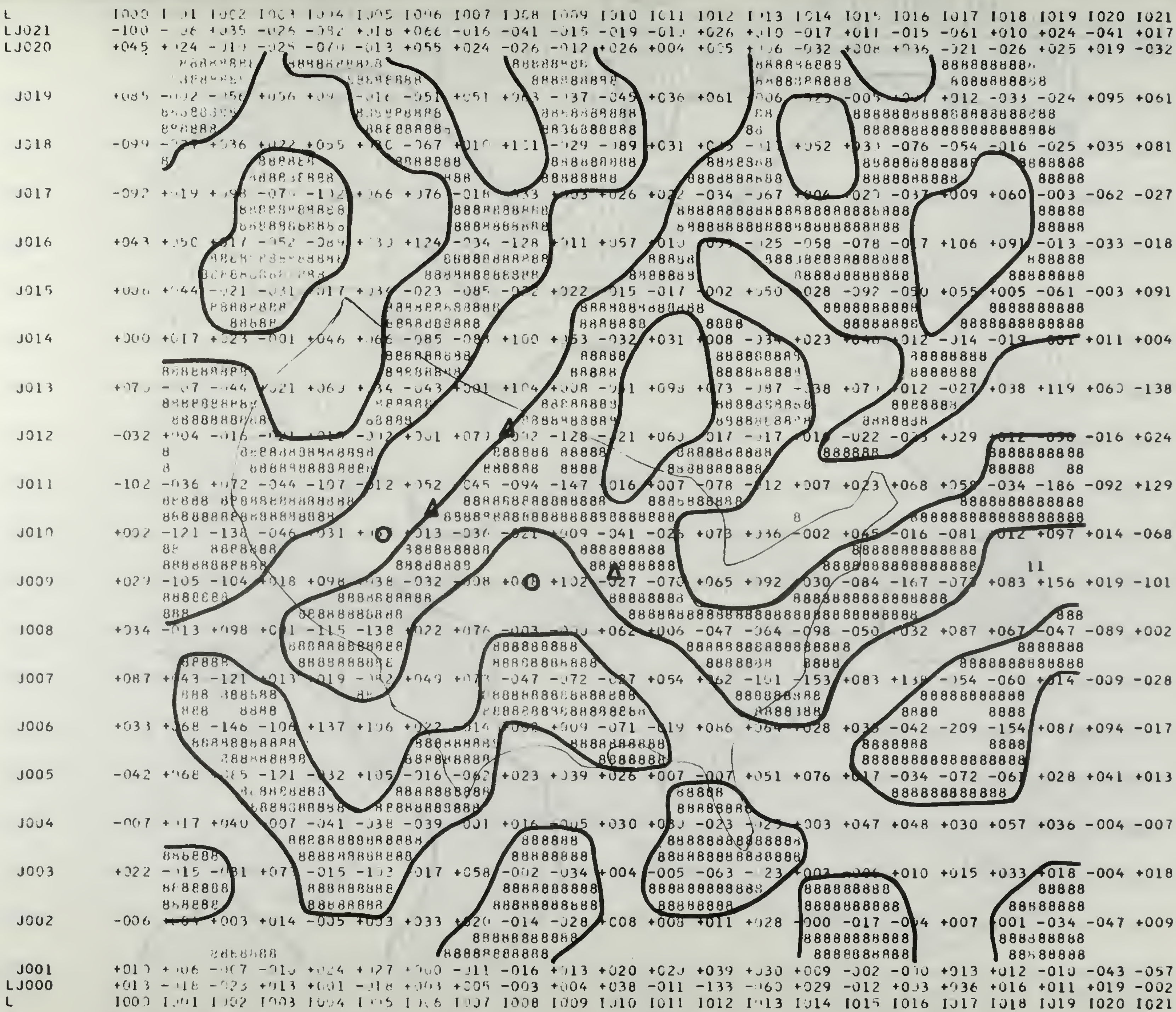
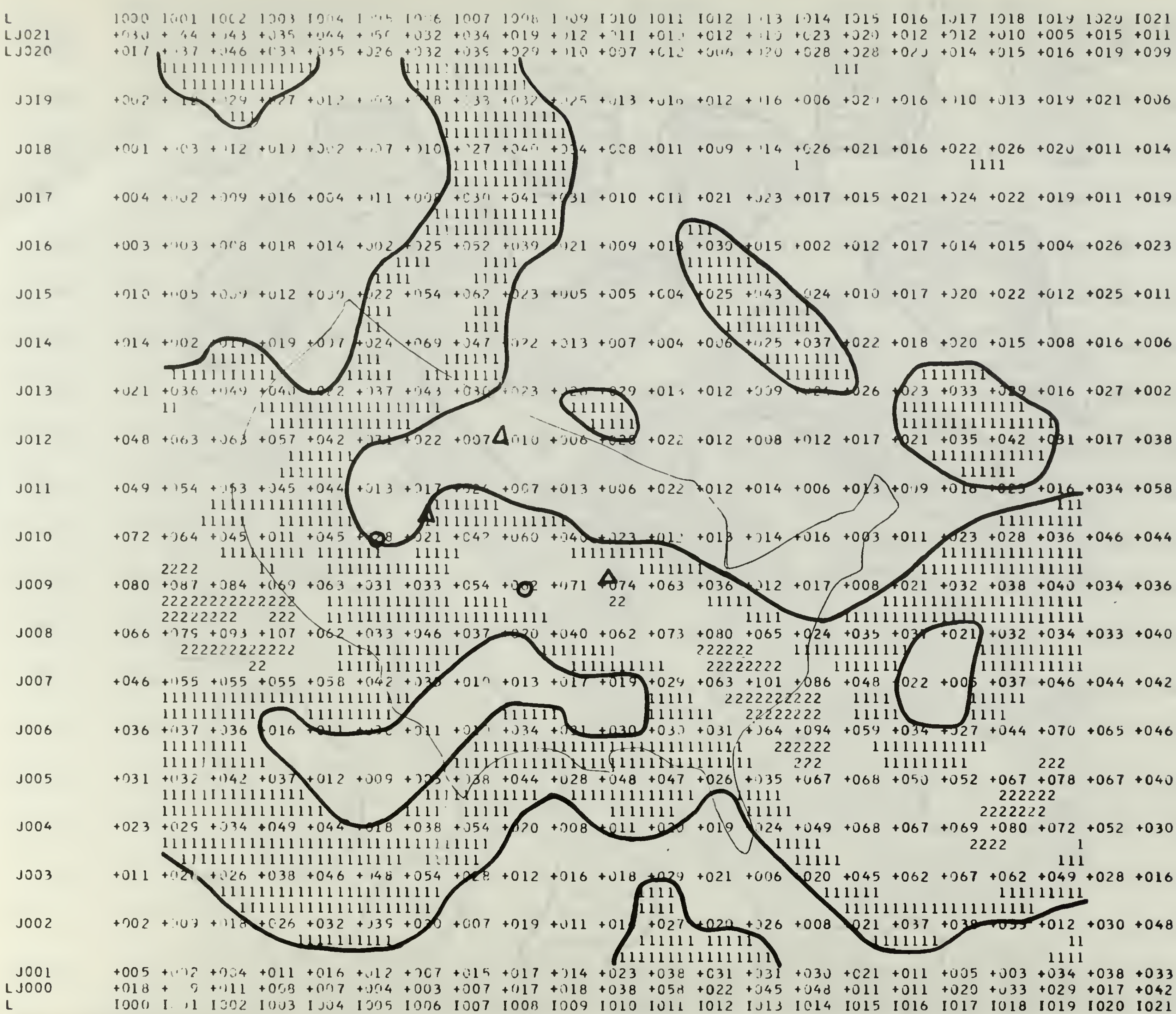
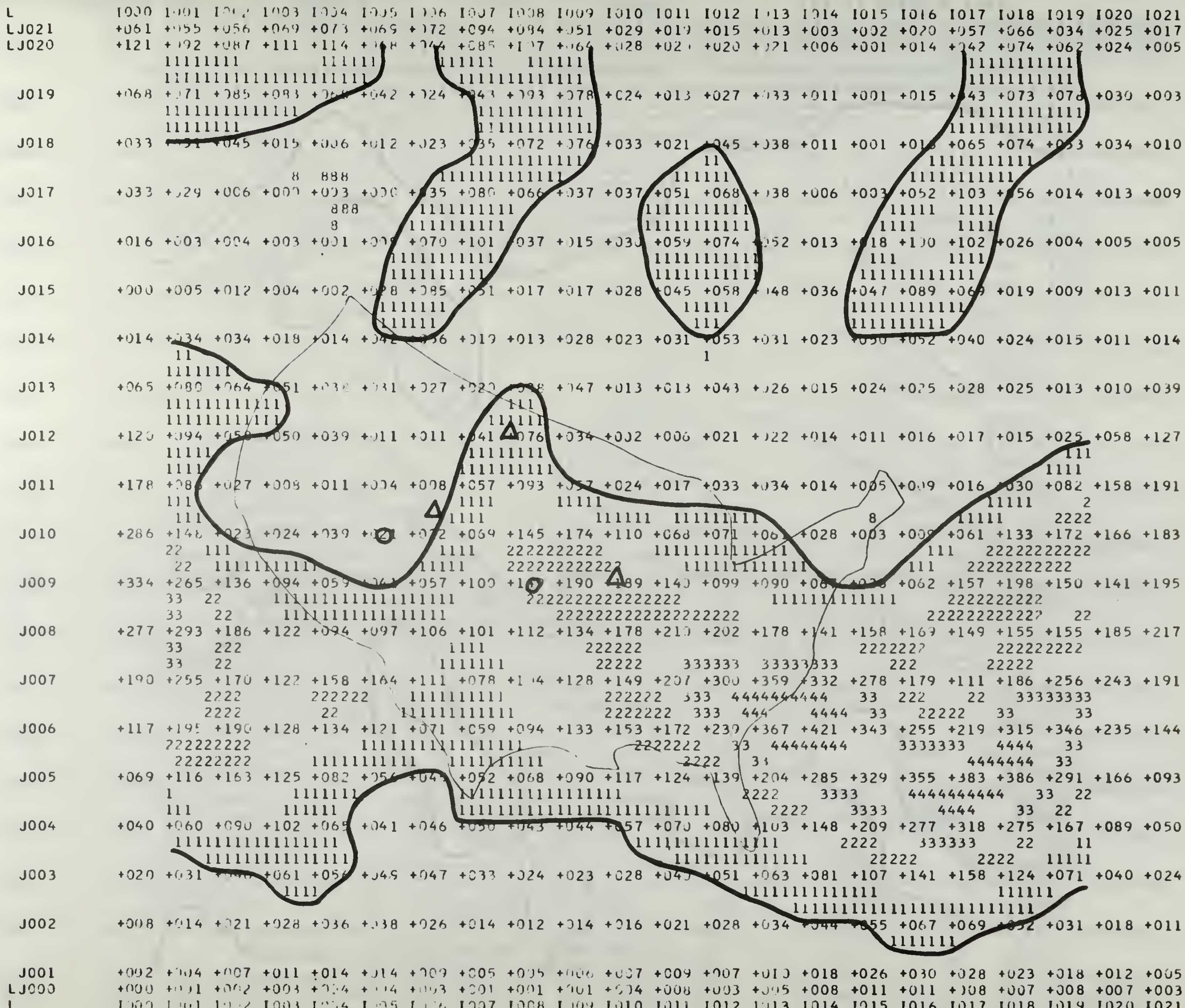


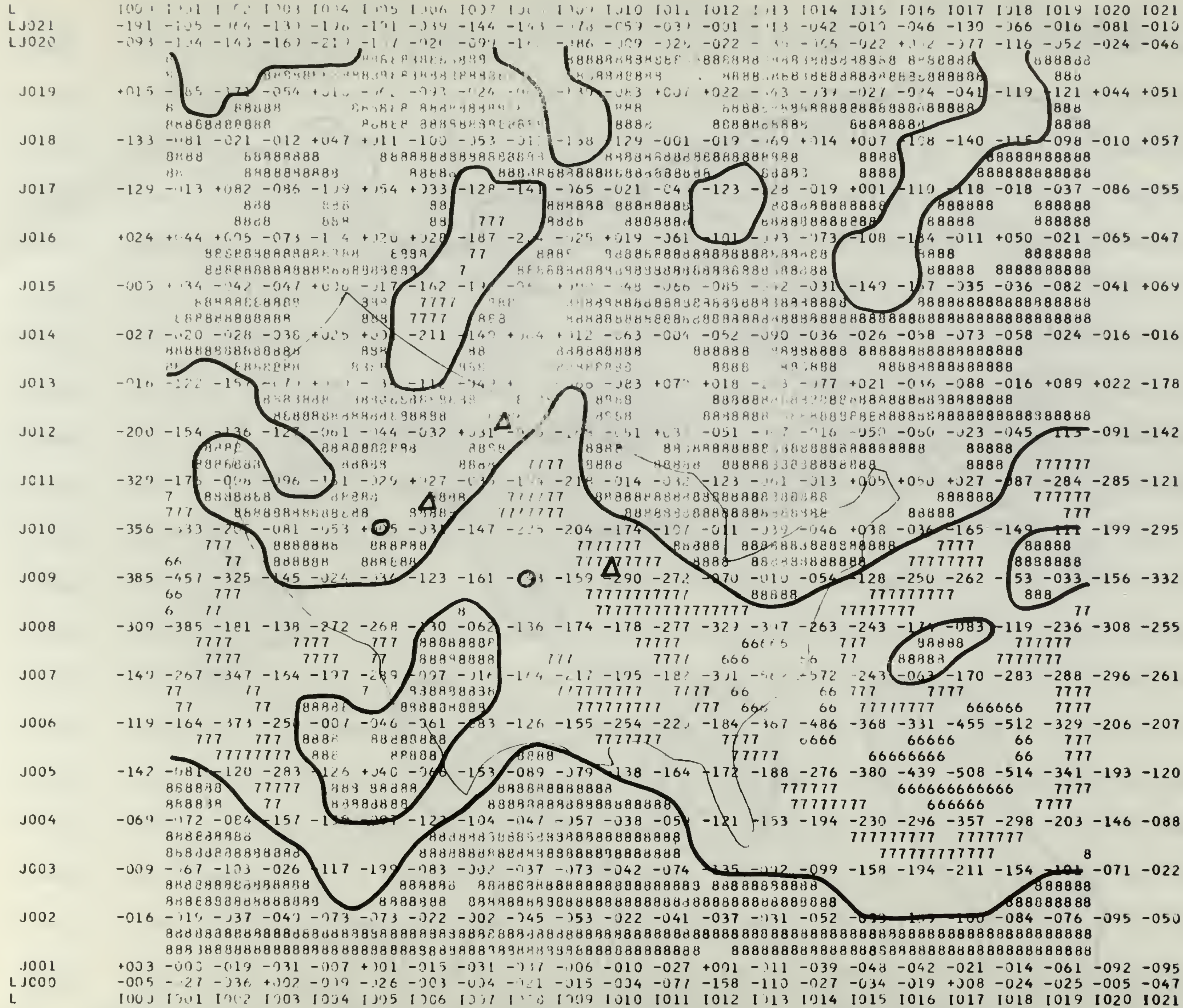
LAPLACIAN OF VORTICITY LAYER 2 PROG. 24 HOURS 12Z 11 MARCH 1965



VERT GRAD CF VT LAYER 2 PROG. 24 HOURS 12Z 11 MARCH 1965



KINETIC ENERGY   LAYER 2   PROG.   24 HOURS   12Z 11 MARCH 1965



PROG KAT FIELD LAYER 2 PROG. 24 HOURS 12Z 11 MARCH 1965

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L         1000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
LJ021     +438 +416 +399 +401 +399 +396 +398 +382 +321 +219 +121 +078 +079 +052 +985 +956 +976 +987 +069 +266 +430 +507
LJ020     +511 +502 +497 +510 +529 +536 +526 +500 +441 +310 +155 +10  +124 +095 +015 +959 +933 +944 +065 +258 +397 +464
               8888888888888888       888888888    77  66   555             4444    3333333333333   44 55  66
               8888888                       8888  77  66   55555           4444    333333333333    44 55  66
J019      +592 +600 +611 +640 +669 +670 +648 +600 +514 +387 +254 +190 +161 +089 +006 +948 +941 +019 +176 +328 +399 +411
                    111111111        1111111    888  77  666    555555   4444    33333333333  44   55  66
               111111111               11111    888  777  666    5555    444    3333333333  44  5  666
J018      +662 +678 +701 +741 +764 +756 +723 +663 +565 +440 +330 +247 +154 +051 +976 +930 +959 +107 +291 +394 +400 +384
                         222222222222       111   888   777  6666    555  444    333333  3333  44 55  66   77777
                      2222222222222222      111   888   777   666    555  444   33333    3333  44 55 66   777777
J017      +715 +737 +765 +794 +793 +772 +739 +672 +567 +445 +347 +256 +130 +006 +926 +901 +975 +147 +329 +414 +403 +381
                 222222222222222222        1111   88   777   6666  55   44  3333        333  44 55  66   777777
               222222222222222222         1111  888  7777   6666  555  44  333         333 44  55 666    77777
J016      +748 +767 +782 +787 +757 +719 +693 +632 +529 +428 +356 +275 +137 +994 +903 +905 +029 +204 +339 +401 +403 +395
               222222222222        11111111     888    777     6666  55  44  3333     333  44  5   666       777
               22222222222       1111111     8888    7777     6666  55  44  333333333   44  55  6666       77
J015      +755 +762 +762 +744 +705 +652 +600 +550 +489 +421 +365 +300 +173 +025 +961 +002 +117 +249 +336 +381 +408 +427
                             11111     888888     777777      6666  55  444        4444  555   66666       7
                           111111    88888     7777777       666   55  444      4444   555   66666       77
J014      +739 +730 +725 +698 +648 +577 +506 +462 +432 +400 +364 +324 +226 +089 +053 +116 +186 +253 +315 +372 +425 +468
                      1111111     8888     7777777777          66666  555   44444     555555    66666      77
               1111111111111    8888     777777777           666666   555          555555    66666      77
J013      +705 +674 +662 +640 +581 +510 +462 +423 +391 +371 +343 +323 +276 +191 +149 +167 +203 +253 +314 +376 +445 +513
               11111         88888       777777777     666666666666     55555555555555555   66666    777
                           888888     7777777777     6666666666666     5555555555555555    6666     777
J012      +659 +616 +594 +574 +537 +501 +478 +449 +422 +379 +315 +295 +292 +257 +210 +181 +187 +224 +286 +372 +471 +558
                   8888888888888                777777777  66666666666666    55555555555555555   666   777
                 8888888888888888                  777777  66666   6666666    555555555555555555  666  77
J011      +623 +576 +548 +533 +529 +524 +511 +493 +474 +413 +312 +273 +290 +270 +226 +201 +181 +165 +215 +349 +489 +589
               8888888888888888888888888                 7777  66666  666666        5555555555     5555   66 777
               8888888888888888888888888888               777   66666  66666666       55555555     5555   66  77
J010      +616 +561 +527 +522 +535 +540 +535 +518 +497 +447 +343 +287 +307 +297 +262 +235 +192 +158 +199 +326 +477 +602
               888888888888888888888888888888888         777   666666666666666666       555555555555   66  77
               88888888888888888888888888888888888        777    6666666666666666666      5555555555  666  77
J009      +637 +587 +552 +537 +541 +553 +559 +547 +532 +502 +425 +367 +358 +338 +317 +286 +234 +221 +257 +337 +471 +614
                   8888888888888888888888888888888888888     777777                 66666666         66666   77
                       888888888888888888888888888888888888     777777777                6666666666666666   77
J008      +680 +644 +614 +587 +576 +579 +584 +593 +598 +589 +548 +491 +451 +419 +398 +377 +337 +324 +347 +401 +511 +637
               11111                                          888888         777777777777           7777
               111111111                        1111111     88888888         777777777    77777777    8
J007      +729 +701 +679 +657 +644 +636 +632 +648 +666 +665 +639 +603 +572 +540 +518 +488 +444 +431 +453 +498 +585 +683
                    111111111111111111111111111111111111111111111           88888888888                8888
                          11111111111111111111111       111111111111111        888888           888888
J006      +767 +747 +736 +724 +716 +715 +716 +716 +722 +718 +700 +694 +678 +643 +621 +583 +527 +520 +551 +592 +661 +738
               2                                                   1111111111     8888888888888     111
               222222222222          22222222                          1111111111                  11111
J005      +794 +783 +778 +778 +776 +778 +782 +781 +779 +778 +771 +770 +760 +731 +705 +669 +626 +615 +636 +673 +726 +782
               222222222222222222222222222222222222222222222222222222222222          11111111111111111111
               22222222222222222222222222222222222222222222222222222222222222222         1111111111111
J004      +815 +808 +808 +814 +819 +817 +821 +831 +837 +839 +837 +831 +823 +806 +780 +747 +720 +709 +717 +741 +779 +816
               222222222                                                 22222222222                 22222
                                                                            222222222222222   222222222222
J003      +829 +826 +829 +836 +845 +851 +858 +869 +877 +878 +876 +871 +862 +847 +827 +802 +784 +780 +785 +797 +820 +842
                                                    333333333333333333                  2222222222222222222222
                                                333333333333333333333333333                 2222222222222
J002      +838 +838 +842 +850 +861 +873 +882 +889 +894 +897 +895 +890 +880 +866 +851 +838 +831 +829 +831 +836 +845 +856
                                          33333333333333333333333333333333333
                                         333333333333333333333333333333333333
J001      +843 +844 +849 +857 +868 +879 +889 +896 +900 +901 +899 +894 +885 +873 +860 +855 +856 +856 +857 +857 +856 +860
LJ000     +845 +847 +852 +860 +869 +878 +887 +895 +898 +897 +894 +890 +885 +874 +860 +858 +865 +868 +868 +868 +864 +863
L         1000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M       LOWER LEVEL Z FIELD     LAYER 1            PROG.      24 HOURS              00Z 12 MARCH 1965
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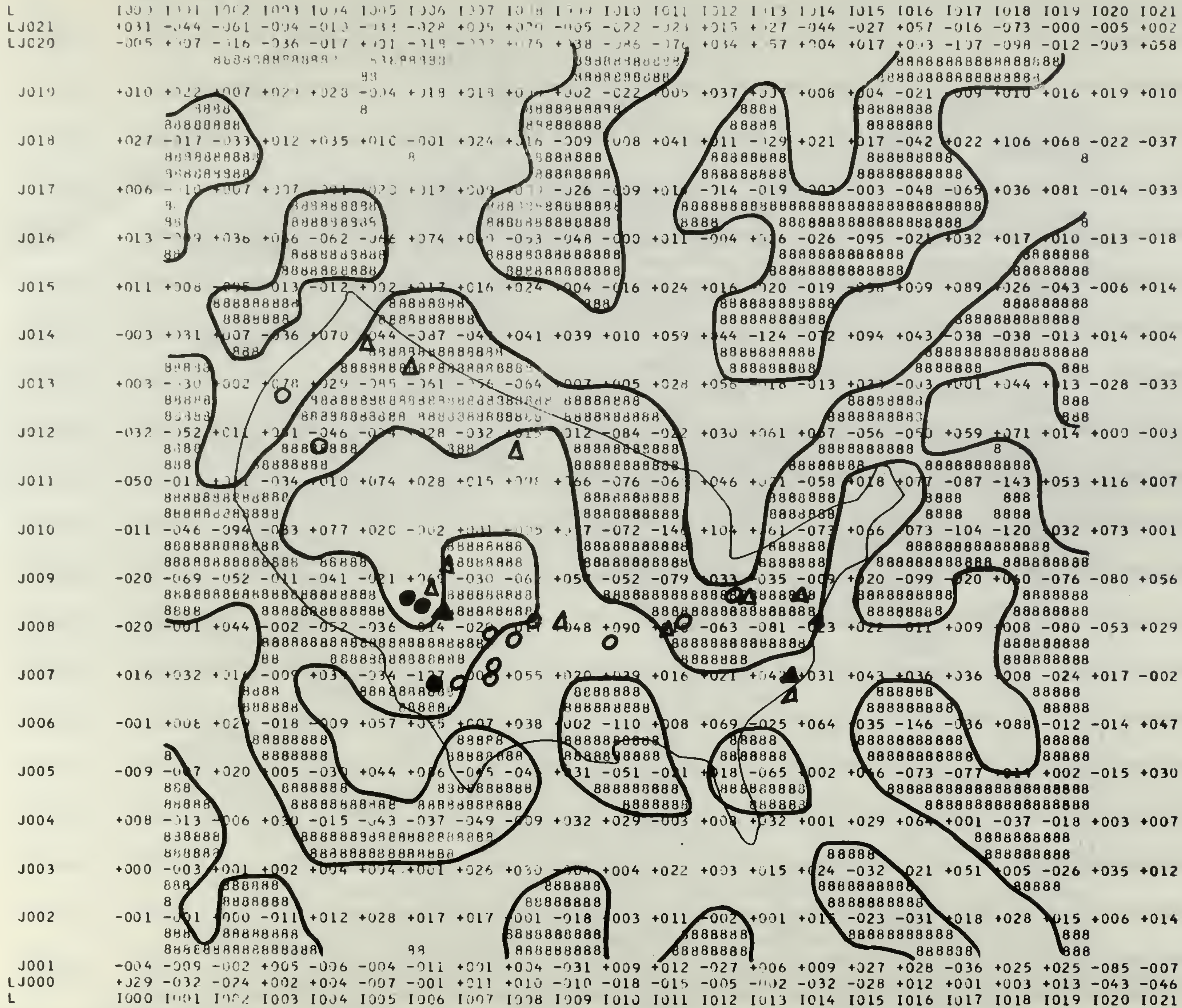
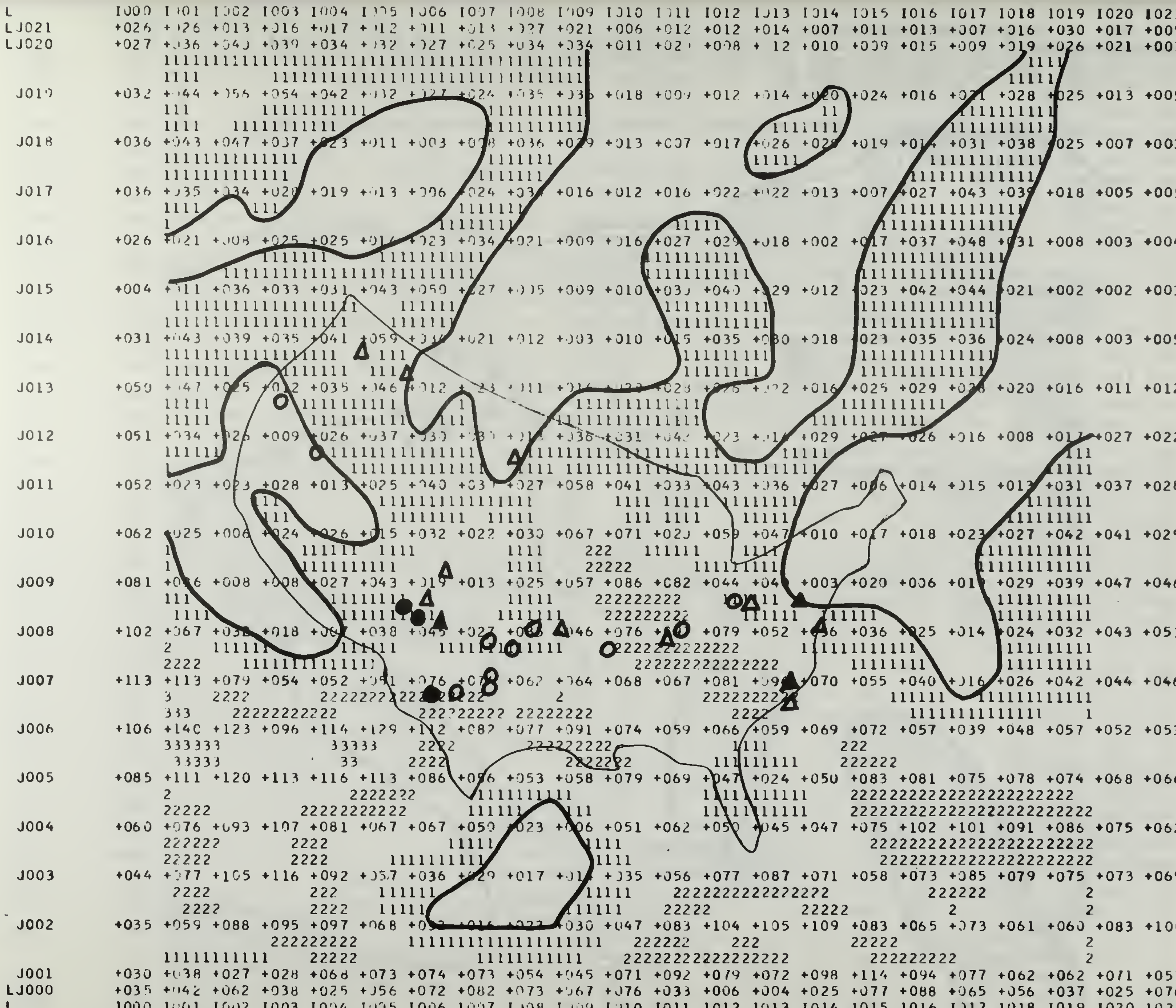
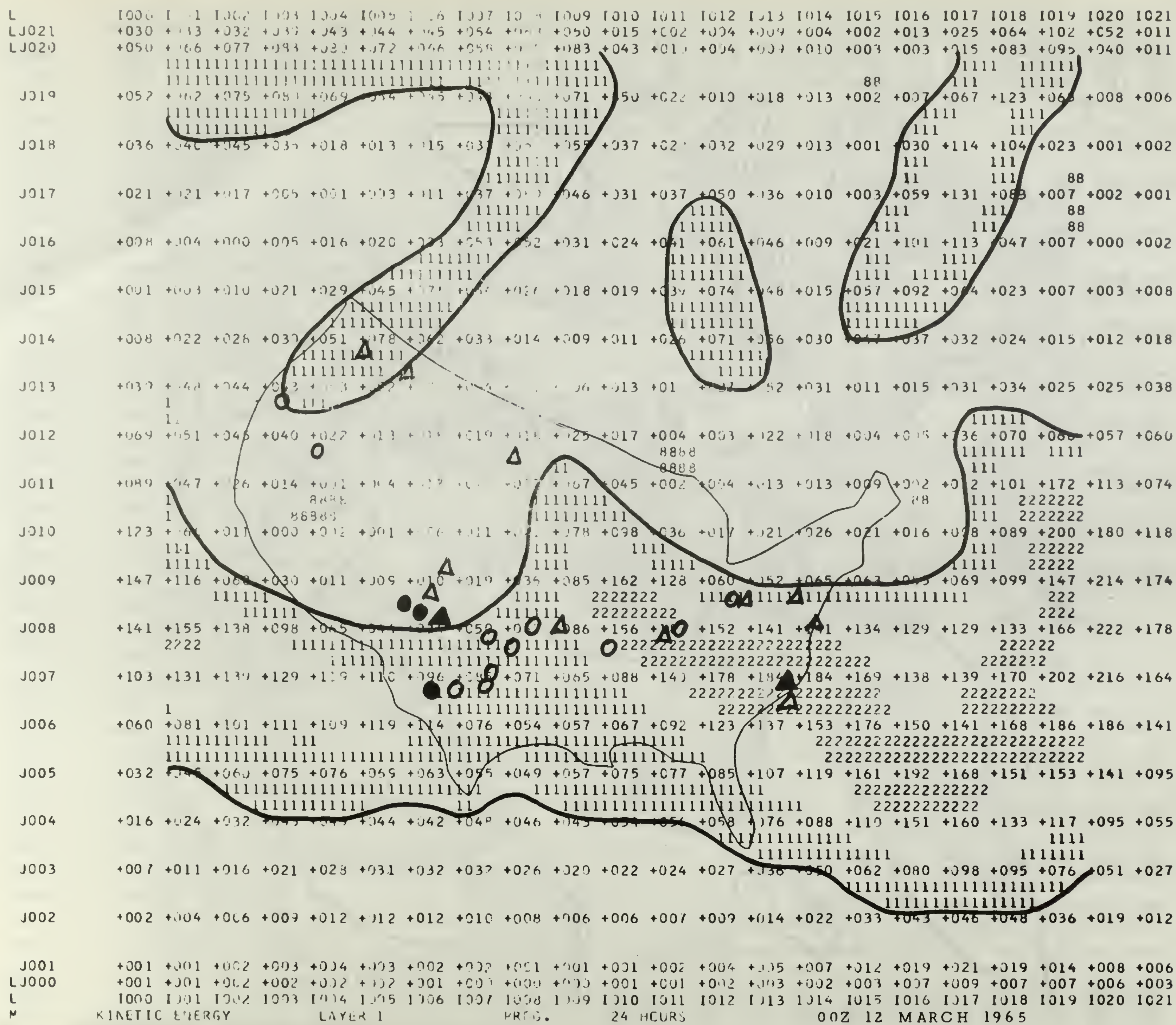
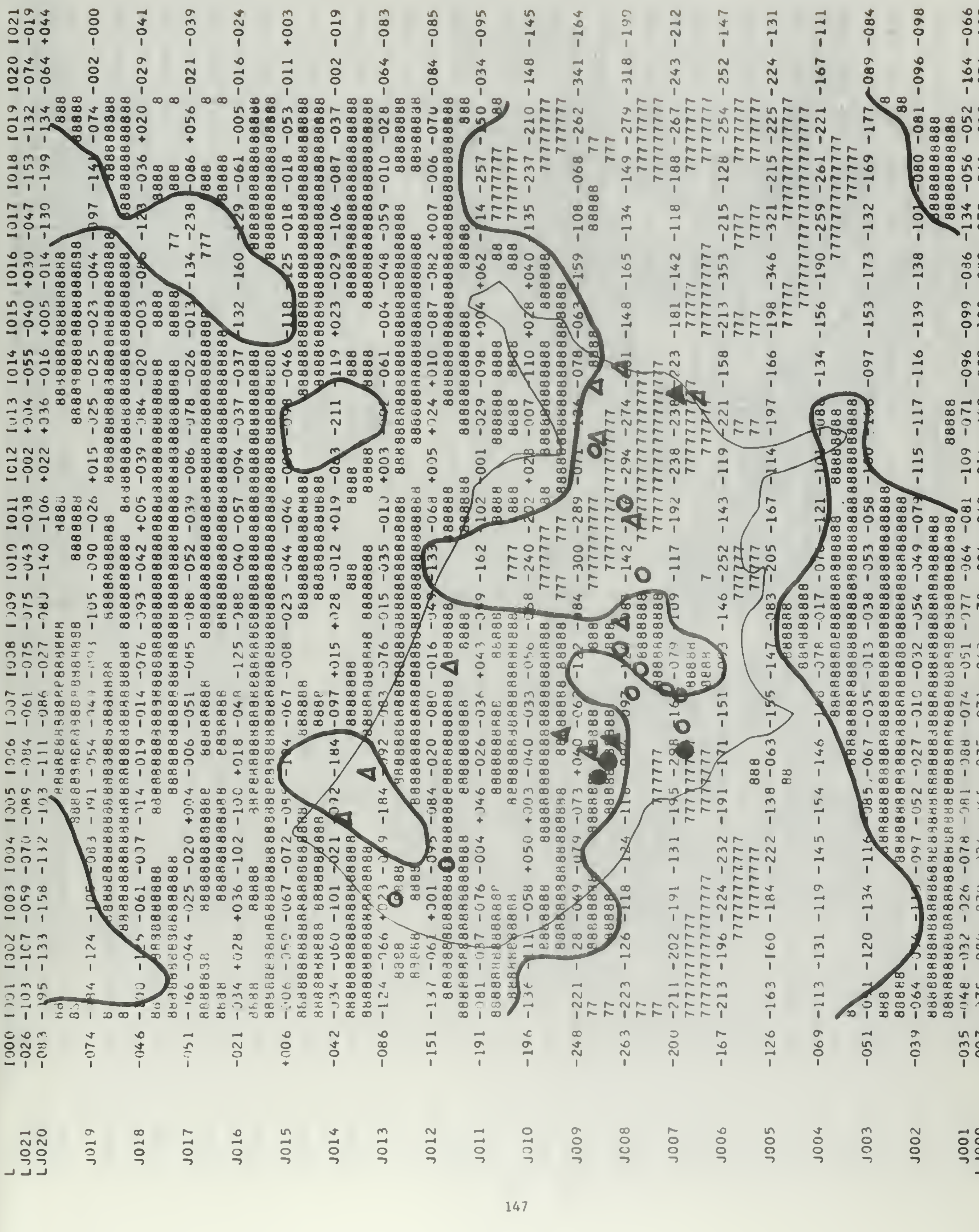


LAPLACIAN CF VORTICITY LAYER 1 PROG. 24 HOURS 00Z 12 MARCH 1965



M VERT GRAD OF VT LAYER 1 PROG. 24 HOURS 00Z 12 MARCH 1965


KINETIC ENERGY
LAYER 1
PROG.
24 HOURS
00Z 12 MARCH 1965


PROG KAT FIELD
LAYER 1
PROG.
24 HOURS
00Z 12 MARCH 1965

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L          I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
LJ021      +893 +867 +883 +884 +887 +888 +886 +882 +875 +862 +851 +846 +844 +840 +832 +833 +839 +841 +852 +874 +893 +902
LJ020      +903 +910 +898 +899 +902 +904 +903 +901 +893 +876 +858 +850 +849 +844 +834 +830 +830 +833 +848 +872 +890 +898
                888888888888888888888888888888888888888   777    6666666     555555555555555555555    66   7777
                888888888888                      88888   777    666666666   555555555  5555555   66   77777
 J019      +915 +915 +916 +919 +921 +922 +921 +917 +904 +886 +868 +859 +852 +843 +833 +828 +829 +841 +862 +880 +890 +892
                           1111111111111111        888   7777   6666666    55555555    55555   666   7777
                    11111111111111111111111111      888   7777   666666   5555555     55555  666  7777
 J018      +925 +926 +929 +932 +934 +933 +932 +925 +910 +890 +875 +865 +852 +838 +829 +826 +831 +851 +878 +892 +893 +890
                111111111111111111111111111111     888   77777    66666   555555        5555  66   777
                1111111          11111111111       888   77777    6666    55555         555   66   777
 J017      +933 +935 +938 +938 +937 +935 +933 +924 +908 +890 +878 +867 +852 +836 +825 +823 +833 +856 +882 +896 +894 +890
                                11111111111111    888   777777    6666   55555         5555  666  777
                                11111111111111   8888   777777    6666   55555         555   66   777
 J016      +938 +940 +942 +941 +934 +930 +927 +918 +903 +889 +879 +868 +854 +837 +825 +825 +840 +864 +883 +893 +893 +892
                              111111111111     8888     7777777     666    5555       5555  666   77777
                             111111111      888888     777777     6666   55555    55555   66   77777
 J015      +939 +940 +939 +936 +929 +922 +914 +907 +897 +891 +882 +873 +857 +839 +830 +834 +850 +870 +883 +889 +893 +896
                         1111111111     88888888          77777777    666    5555555555    6666   7777777
                    111111111111      888888              77777777   6666   555555555    6666    777777
 J014      +937 +935 +932 +929 +923 +911 +898 +893 +893 +890 +883 +876 +862 +843 +838 +845 +857 +870 +882 +890 +895 +899
                111111111111      8888                 777777777     6666              66666    777777
                11111111111      8888       7777777'7777777777      6666              666666   777777
 J013      +933 +927 +924 +922 +915 +902 +890 +886 +886 +885 +878 +873 +866 +855 +849 +852 +859 +869 +882 +892 +899 +904
                               88888         77777777777777777           6666666666666666666666     7777
                             888888              777777777777            666666666666666666666      77777    8
 J012      +927 +918 +916 +913 +908 +901 +895 +891 +890 +884 +872 +868 +869 +864 +858 +856 +858 +865 +877 +893 +905 +913
                    88888888888888888888                77777               6666666666666666666     777   88
                  8888888888888888888888888             7777                 6666666666666666666     777   88
 J011      +924 +912 +906 +905 +905 +905 +903 +901 +899 +890 +874 +868 +872 +869 +862 +860 +859 +857 +868 +890 +910 +921
                8888888888888888888888888888888888888        7777                 66666666666666666666   77   88
                888888888888888888888888888888888888888       7777                  6666666666666666   77   88
 J010      +925 +911 +903 +902 +904 +906 +907 +906 +904 +898 +883 +875 +870 +875 +867 +865 +861 +857 +866 +887 +909 +925
                 88888888888888888888888888888888888888888  .  77777777777777777            6666666666   777   8
                 888888888888888888888888888888888888888888888    777777777777777             6666666   7777   8
 J009      +930 +917 +909 +906 +906 +907 +910 +911 +911 +909 +899 +890 +888 +883 +877 +873 +867 +865 +874 +888 +907 +926
                     888888888888888888888                888888           77777777777                  77777   88
                1       88888888888                    88888888              77777777777          7777777   88
 J008      +938 +928 +921 +917 +914 +914 +916 +919 +922 +923 +917 +909 +902 +897 +892 +887 +881 +880 +885 +895 +911 +929
                1111111                      11111111111            8888888888          7777777777      8888
                 11111111111         111111111111111111111             8888888888                      88888
 J007      +947 +940 +934 +929 +927 +926 +927 +931 +934 +934 +931 +926 +922 +917 +911 +904 +897 +896 +900 +908 +921 +935
                      11111111111111111111111           1111111111111111            88888888888888888888
                          1111111111                  11111111111111              888888888888888      1
 J006      +954 +950 +945 +941 +939 +940 +941 +942 +944 +944 +940 +938 +936 +932 +927 +919 +911 +910 +916 +922 +932 +944
                222222                                                       1111111111                  111111
                2222222222                  2222222222222                       11111111           11111111
 J005      +959 +956 +954 +951 +949 +950 +951 +950 +951 +952 +949 +948 +947 +943 +939 +933 +926 +924 +928 +934 +942 +950
                222222222222222222222222222222222222222222222222222222222222222222            1111111111111111111
                2222222222222222222222222222222222222222222222222222222222222222222222222222          11111111111
 J004      +962 +961 +959 +958 +956 +957 +957 +957 +958 +959 +958 +957 +956 +953 +949 +945 +940 +938 +940 +944 +950 +955
                       2222222222222222222222222222              2222222222222222222222                 222
                                                                      2222222222222222222             2222222
 J003      +964 +964 +963 +963 +962 +963 +963 +963 +964 +964 +964 +963 +962 +960 +956 +953 +950 +950 +950 +952 +956 +959
                                                                           222222222222222222222222222222222
                                                                             222222222222222222222222222222
 J002      +966 +966 +966 +966 +966 +967 +967 +967 +967 +966 +967 +966 +965 +963 +961 +958 +957 +957 +957 +958 +960 +962
                                                                                    2222222222222222222222
                                                                                        2222222
 J001      +966 +966 +967 +967 +968 +968 +969 +969 +959 +968 +968 +968 +966 +965 +964 +962 +961 +961 +962 +962 +962 +964
LJ000      +966 +967 +967 +963 +968 +969 +969 +970 +970 +969 +969 +968 +967 +966 +965 +965 +964 +964 +965 +964 +964 +965
L          I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M        LOWER LEVEL Z FIELD     LAYER 2          PROG.     24 HOURS             00Z 12 MARCH 1965
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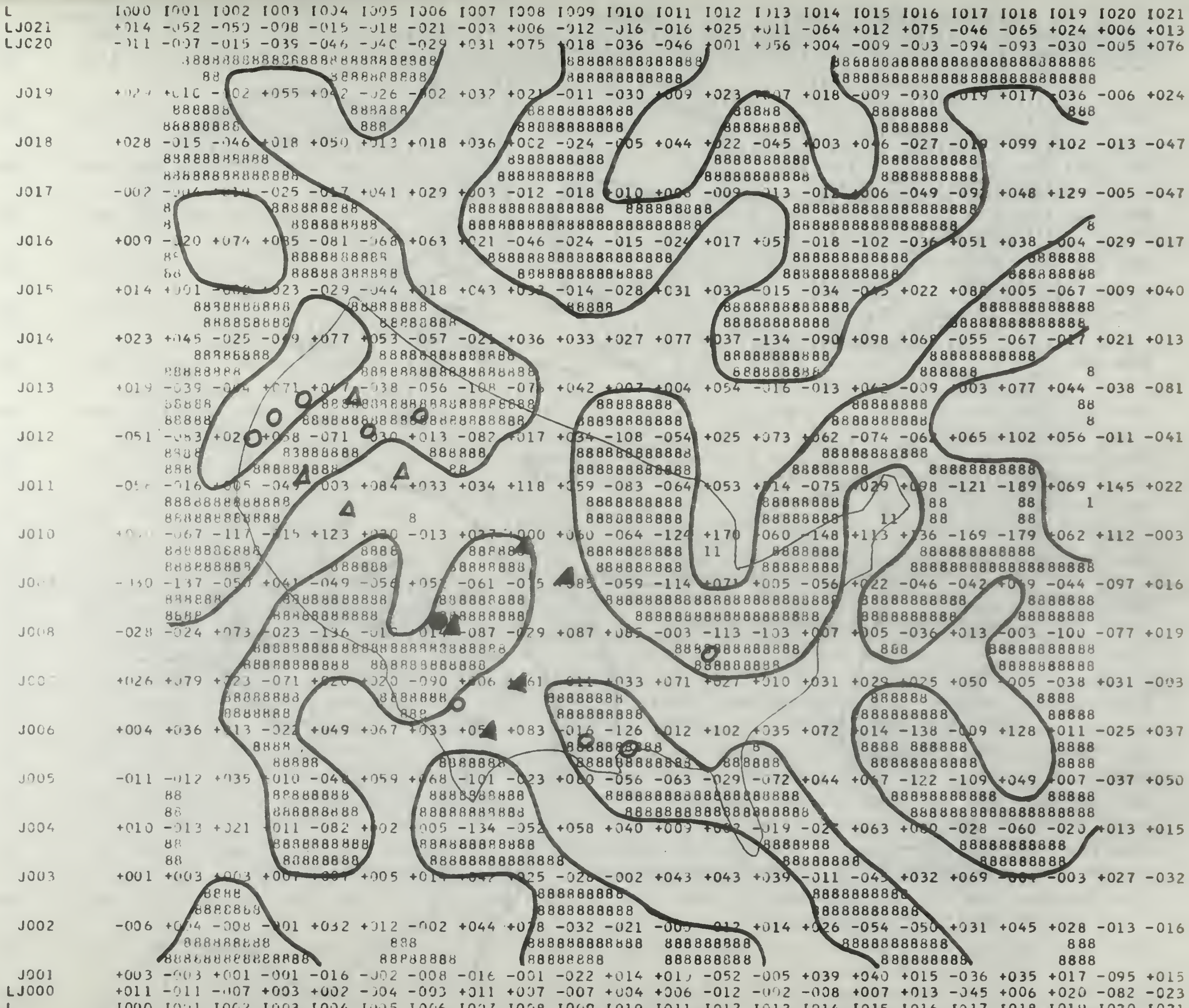
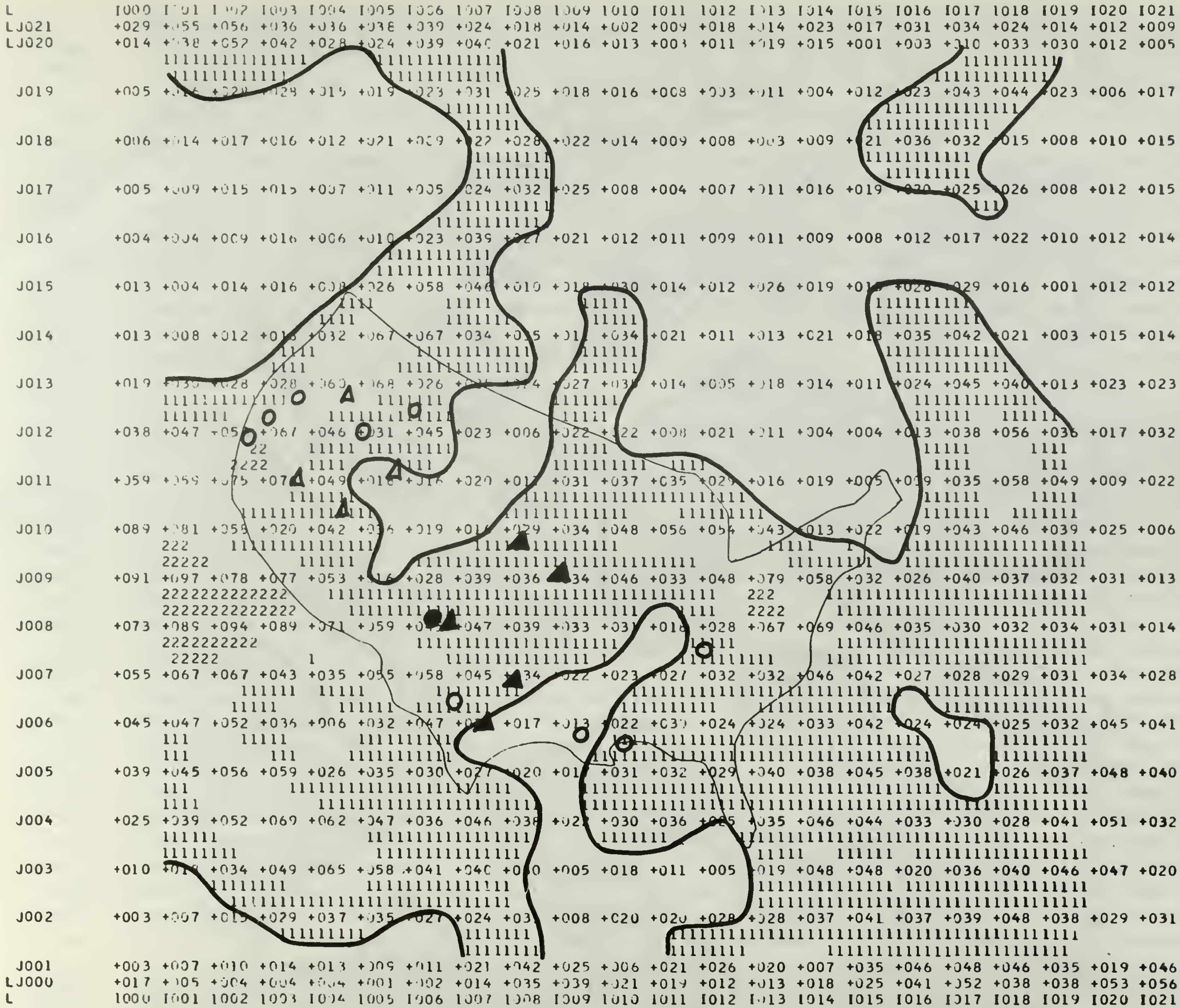
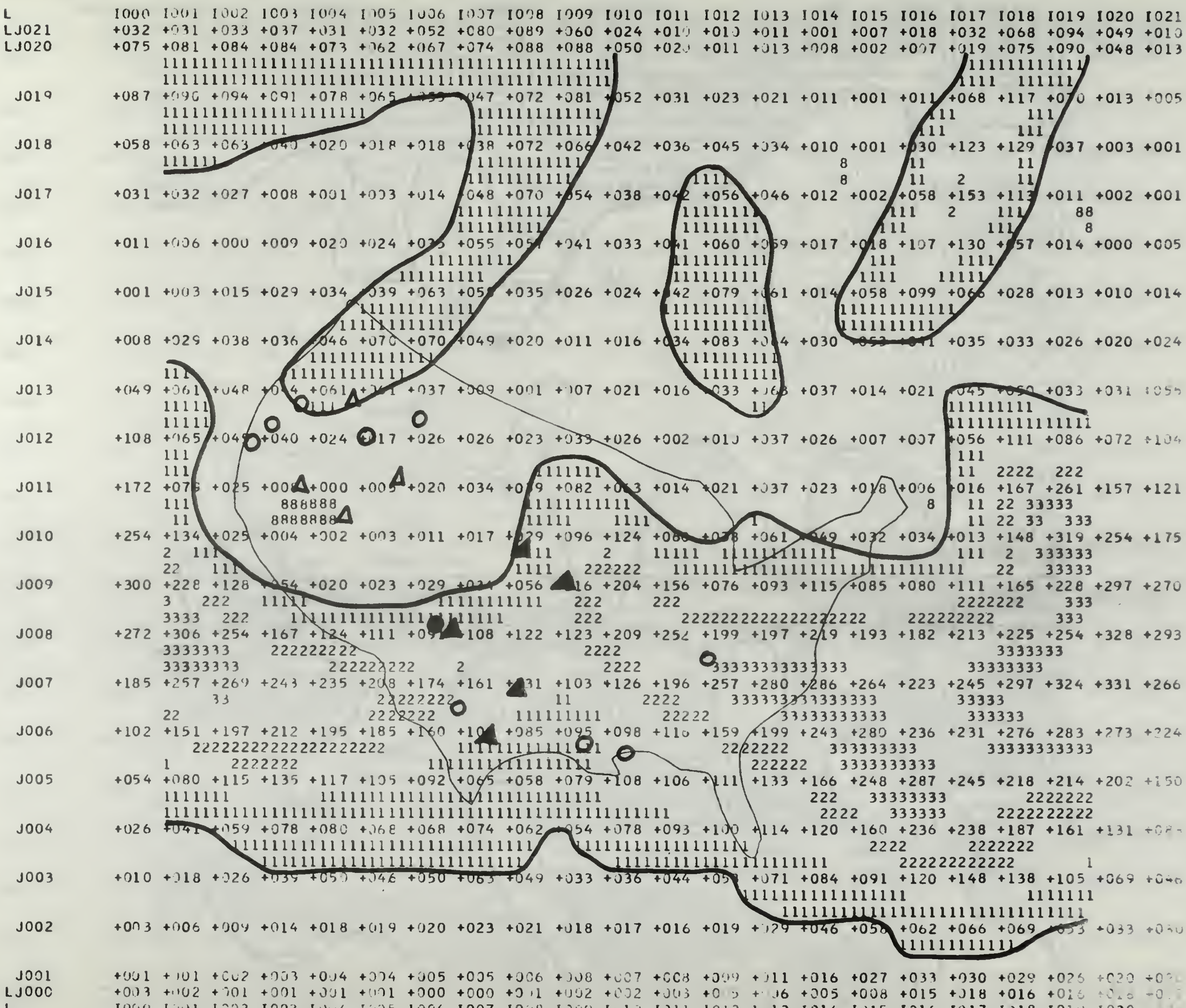


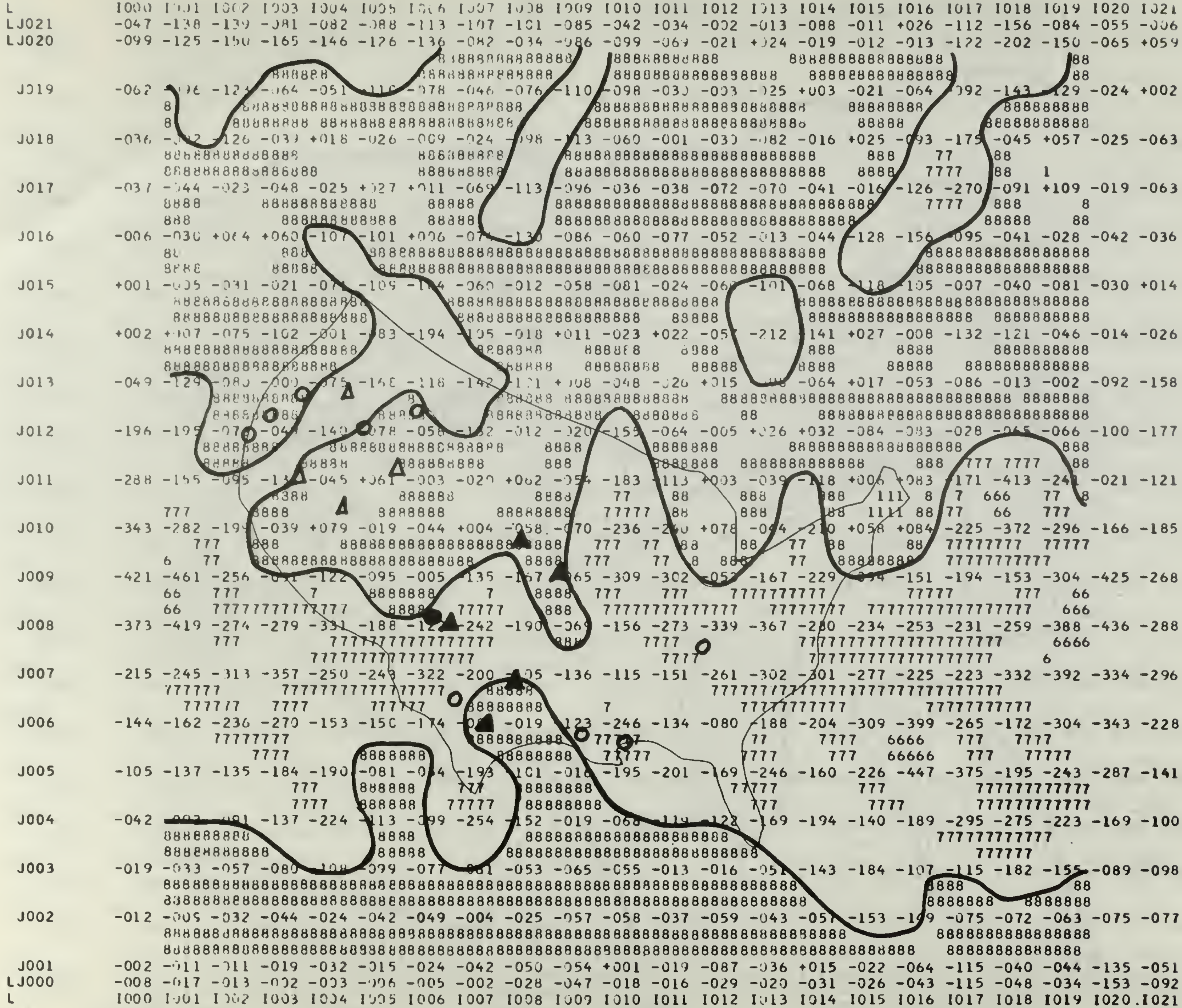
LAPLACIAN OF VORTICITY LAYER 2 PROG. 24 HOURS 00Z 12 MARCH 1965



VERT GRAD CF VT LAYER 2 PROG. 24 HOURS 00Z 12 MARCH 1965



M KINETIC ENERGY LAYER 2 PROG. 24 HOURS 00Z 12 MARCH 1965



PROG KAT FIELD LAYER 2 PROG. 24 HOURS 00Z 12 MARCH 1965

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LJ021      +428 +480 +506 +454 +378 +354 +346 +319 +251 +164 +064 +996 +000 +012 +955 +904 +929 +979 +078 +277 +438 +476
LJ020      +510 +552 +560 +514 +453 +438 +445 +412 +337 +242 +098 +984 +012 +068 +018 +963 +987 +067 +200 +346 +420 +431
                888   8888888                77777   666   55  44           4444444       333      444  55  66     77
                           8888888888              7777   666  55  444      4444444                444  55  66     777
 J019      +580 +612 +624 +628 +607 +567 +550 +517 +437 +348 +226 +087 +043 +058 +026 +988 +020 +141 +302 +404 +419 +403
                 111111111111111            888888   7777   66  55   44444444444               444  5  66     77777
                1111111111      1111111        8888   777   66    55    44444444               44  55  66   777777
 J018      +633 +669 +697 +733 +740 +699 +654 +608 +535 +449 +340 +200 +102 +055 +001 +975 +033 +171 +327 +410 +411 +382
                111                  11111      8888   777  66    55     44444     3333333   44  55  66     77777
                1         22222222     11111     888   777   66   555    4444    33333333   44  55  66     77777
 J017      +676 +709 +739 +765 +779 +755 +714 +648 +570 +482 +373 +251 +159 +065 +947 +924 +037 +195 +325 +394 +400 +372
                          2222222222        1111     888   777   66    555   44  333      333 44  55  666
                            22222          11111   8888   777   666    555   44  33       333 44  55  6666
 J016      +699 +717 +736 +749 +748 +734 +698 +635 +552 +455 +354 +262 +180 +057 +909 +898 +056 +223 +319 +371 +391 +393
                                       111111    8888   777   666    555   44  33       33  4  55    66666
                                  11111111     8888   777   6666     555   44   3333 3333  44  55    66666
 J015      +711 +714 +711 +698 +687 +666 +624 +574 +511 +421 +331 +263 +176 +047 +947 +979 +114 +230 +292 +336 +380 +423
                     111111111111          888888     7777     66666     55   44    3333     44    555       6666666
                   1111111              8888888     77777    666666    555  44            444    5555        666666
 J014      +724 +713 +670 +600 +562 +561 +535 +488 +444 +391 +342 +305 +214 +075 +018 +080 +168 +218 +240 +279 +351 +431
                 11111    8888888888888          7777777          66666    55    444444444    55555555555        666
                11111   8888                   7777777          66666  55    4444444       555555555555555     66
 J013      +719 +689 +611 +608 +456 +469 +472 +435 +396 +376 +365 +351 +284 +167 +101 +126 +177 +192 +182 +212 +305 +411
                111   888     777777777    777777777                 6666   555               5555555555555555
                11    888    7777777777777777777777                  66666    5555           555555555      55555
 J012      +684 +644 +570 +487 +445 +451 +458 +438 +412 +388 +362 +339 +307 +236 +164 +153 +167 +153 +141 +177 +260 +368
                    8888      7777777777  77777777777777           6666666666    5555555 5555555           55555
                    88888         77        7777777777777          66666666666    555555555555555          55555
 J011      +642 +604 +559 +505 +473 +472 +471 +462 +449 +415 +353 +311 +298 +248 +184 +177 +171 +135 +136 +182 +248 +355
                  6883888                          77777777     66666666666     55555555555555         555555
                 888888888                           777777     6666666666       55555555555555      5555555
 J010      +617 +578 +551 +520 +500 +494 +491 +486 +480 +455 +390 +328 +304 +273 +230 +210 +193 +170 +181 +227 +301 +416
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                8888888888888888                           777777       66666666666                         6666
 J009      +622 +578 +555 +541 +533 +520 +515 +520 +516 +500 +463 +410 +364 +329 +303 +276 +255 +256 +275 +318 +395 +503
                  8888888888888888888888888888888888888        7777777       66666666666666666666666666     7
                     888888888888888888888888888888888888888       7777777          66666666666        7777
 J008      +659 +616 +593 +582 +570 +553 +546 +551 +549 +545 +539 +524 +484 +431 +402 +386 +367 +371 +396 +430 +488 +577
                                   888888888888888888888888888888888888888         7777777777777777777777777
                111                                                    888888              77777777          888
 J007      +707 +673 +654 +644 +629 +615 +608 +606 +608 +616 +627 +629 +604 +564 +538 +518 +497 +498 +518 +541 +582 +654
                111111111111111111111                    11111111111111111          8888888888888888888888888
                  111111111111111111111111111111111111111111111111111111111             88888888
 J006      +746 +721 +710 +706 +700 +696 +699 +703 +703 +704 +719 +720 +694 +671 +654 +631 +612 +612 +623 +637 +672 +729
                                                                        111111111111111111111111111111111111
                                                            2222222222           1111111111111111111111
 J005      +774 +757 +751 +753 +753 +755 +769 +783 +782 +778 +790 +791 +769 +747 +737 +722 +706 +701 +706 +716 +743 +786
                2222222222222222222222222222222222222222222222222222222222222222222222
                22222222222222222222222222222222222222222          222222222222222222222222          22222
 J004      +796 +785 +783 +788 +790 +793 +807 +825 +834 +837 +844 +842 +827 +814 +809 +798 +782 +775 +777 +783 +801 +829
                22222222222222222222222222                                    22222222222222222222222222
                2222222222222222222222222                                           222222222222
 J003      +811 +804 +805 +811 +816 +822 +837 +855 +868 +876 +879 +876 +868 +862 +857 +849 +839 +835 +834 +837 +847 +862
                222222222222                           333333333333333
                222222222                            333333333333333333333333
 J002      +822 +818 +820 +827 +833 +841 +856 +873 +885 +892 +894 +893 +886 +879 +878 +876 +871 +867 +866 +869 +873 +879
                                                333333333333333333333333333333333333333333333
                                               3333333333333333333333333333333 33333333333333
 J001      +829 +827 +829 +837 +844 +851 +864 +879 +850 +895 +895 +891 +882 +879 +884 +887 +882 +877 +879 +881 +881 +883
LJ000      +834 +833 +836 +842 +849 +855 +865 +877 +887 +891 +889 +880 +876 +880 +885 +885 +883 +881 +882 +882 +883 +886
L          I000 I001 I002 I003 I004 I005 I006 I007 I008 I009 I010 I011 I012 I013 I014 I015 I016 I017 I018 I019 I020 I021
M       LOWER LEVEL Z FIELD     LAYER 1          PROG.      24 HOURS          12Z 12 MARCH 1965
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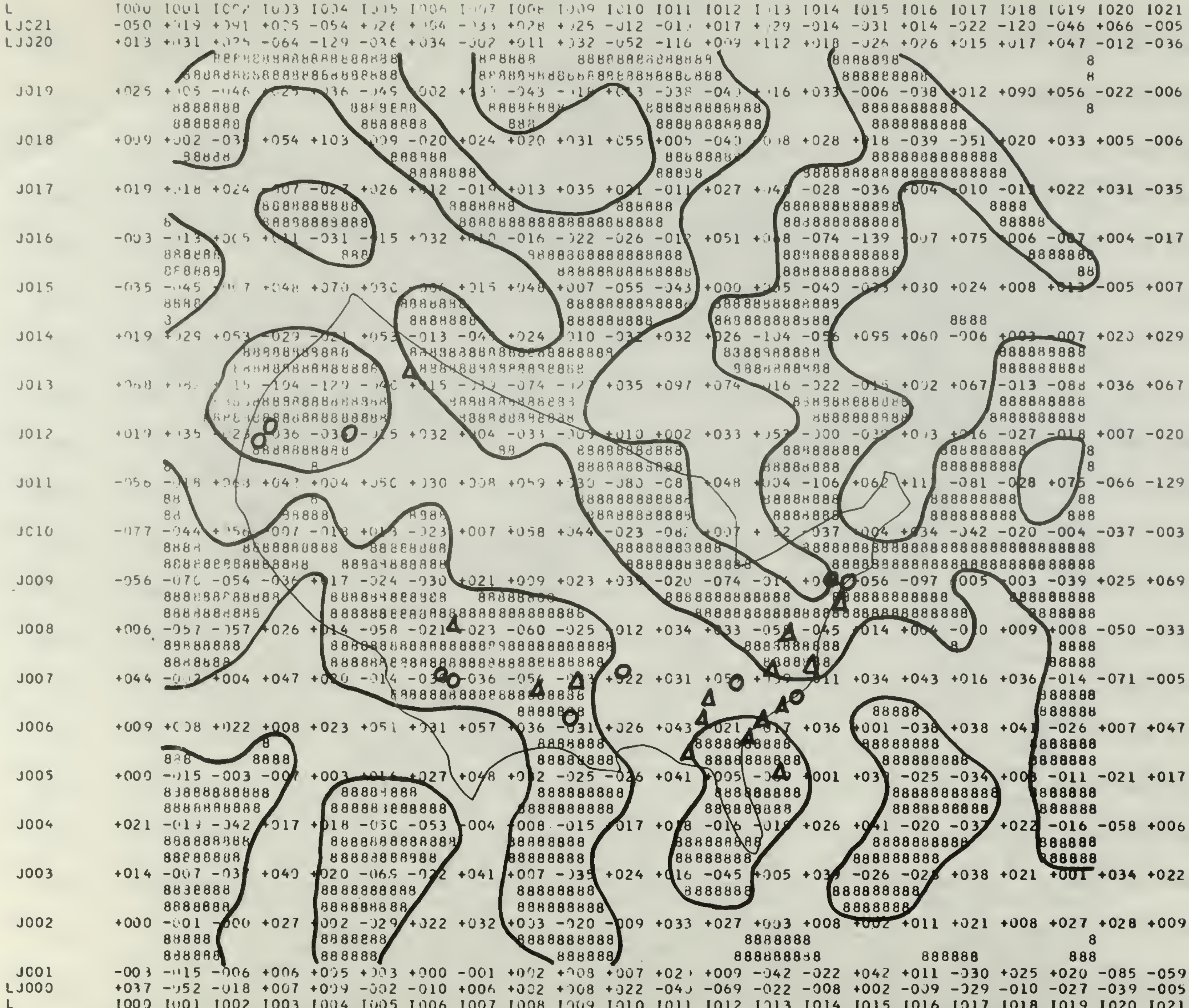
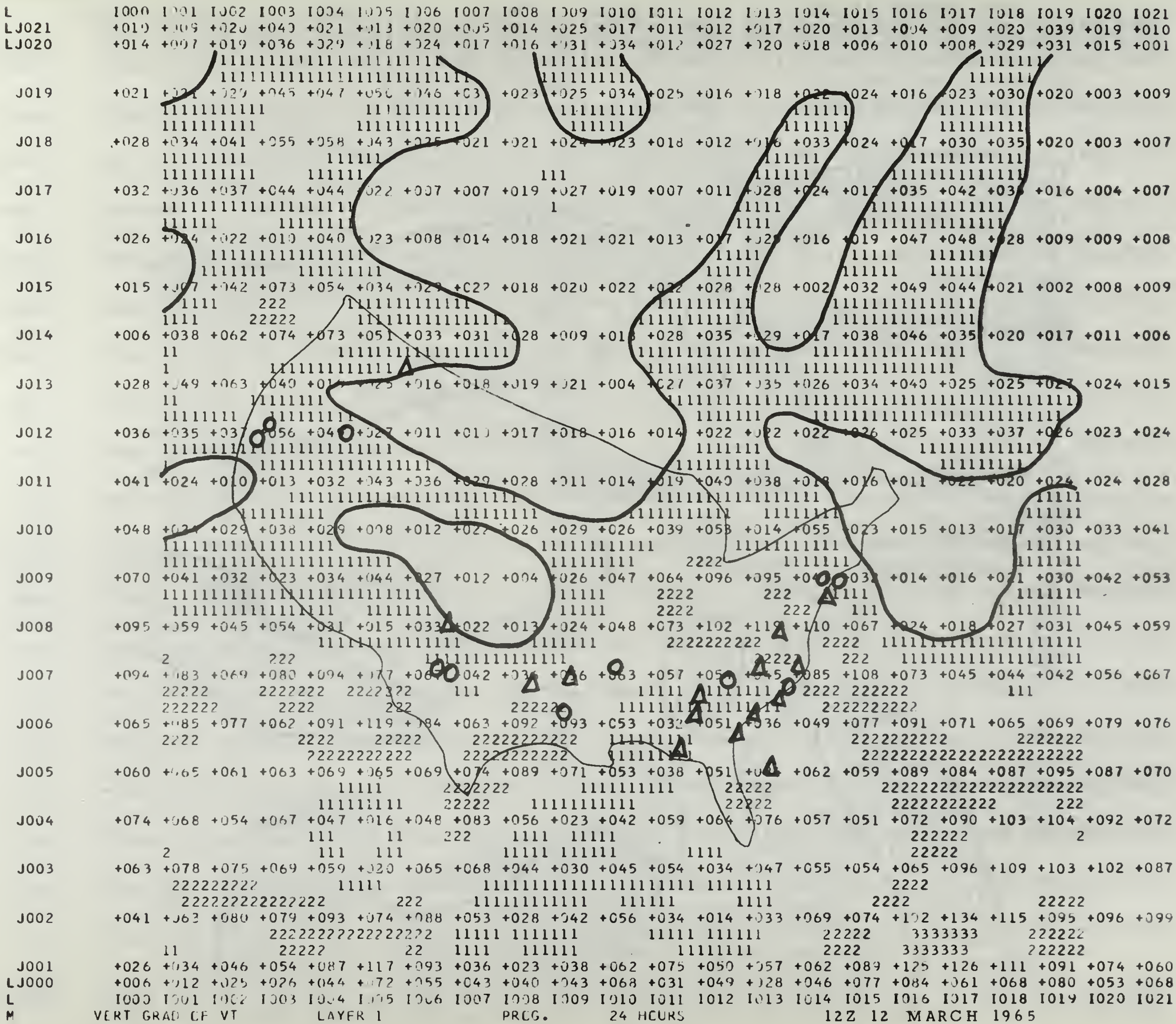
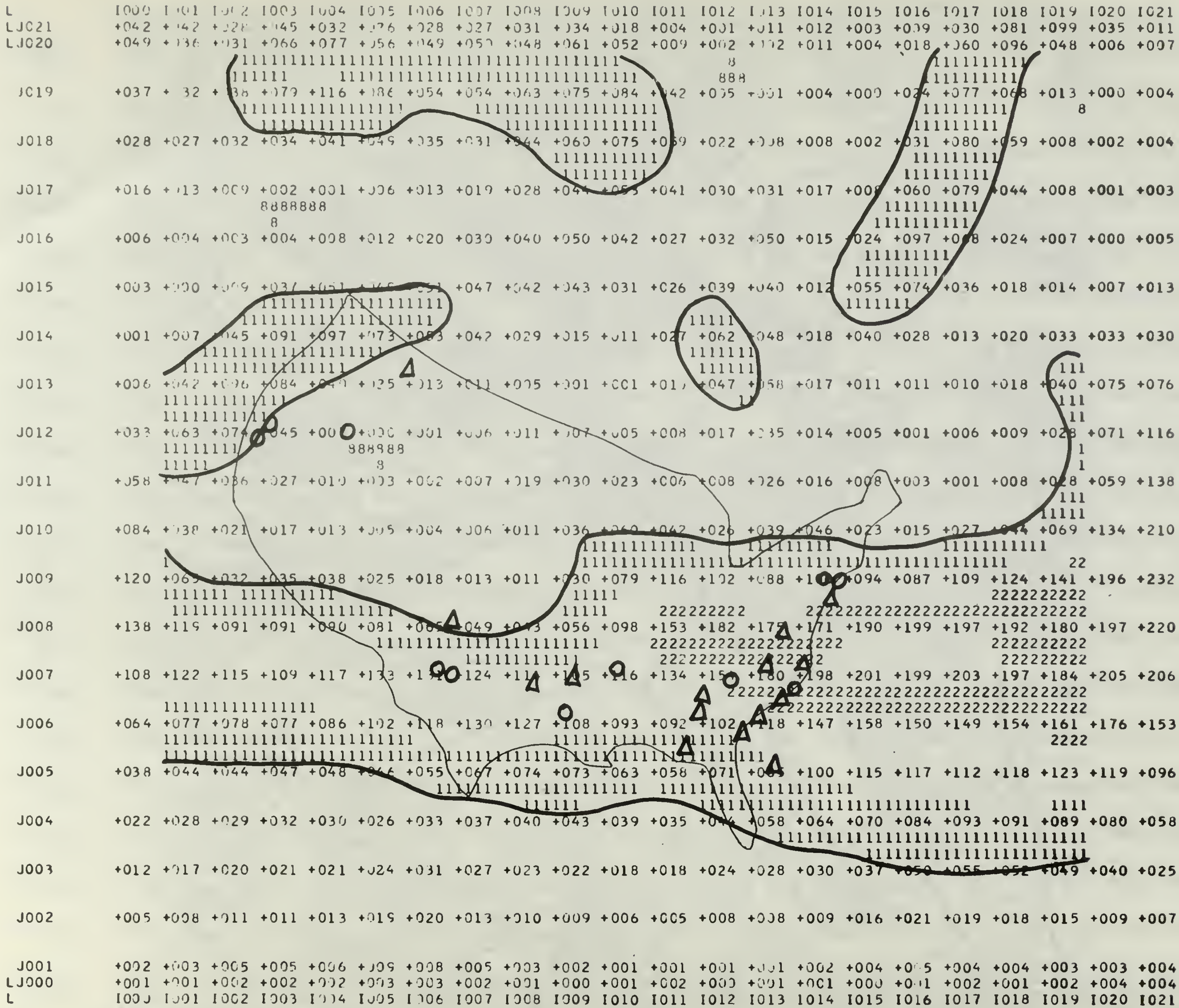


LAPLACIAN OF VORTICITY LAYER 1 PROG. 24 HOURS 12Z 12 MARCH 1965


VERT GRAD CF VT
LAYER 1
PROG.
24 HOURS
12Z 12 MARCH 1965



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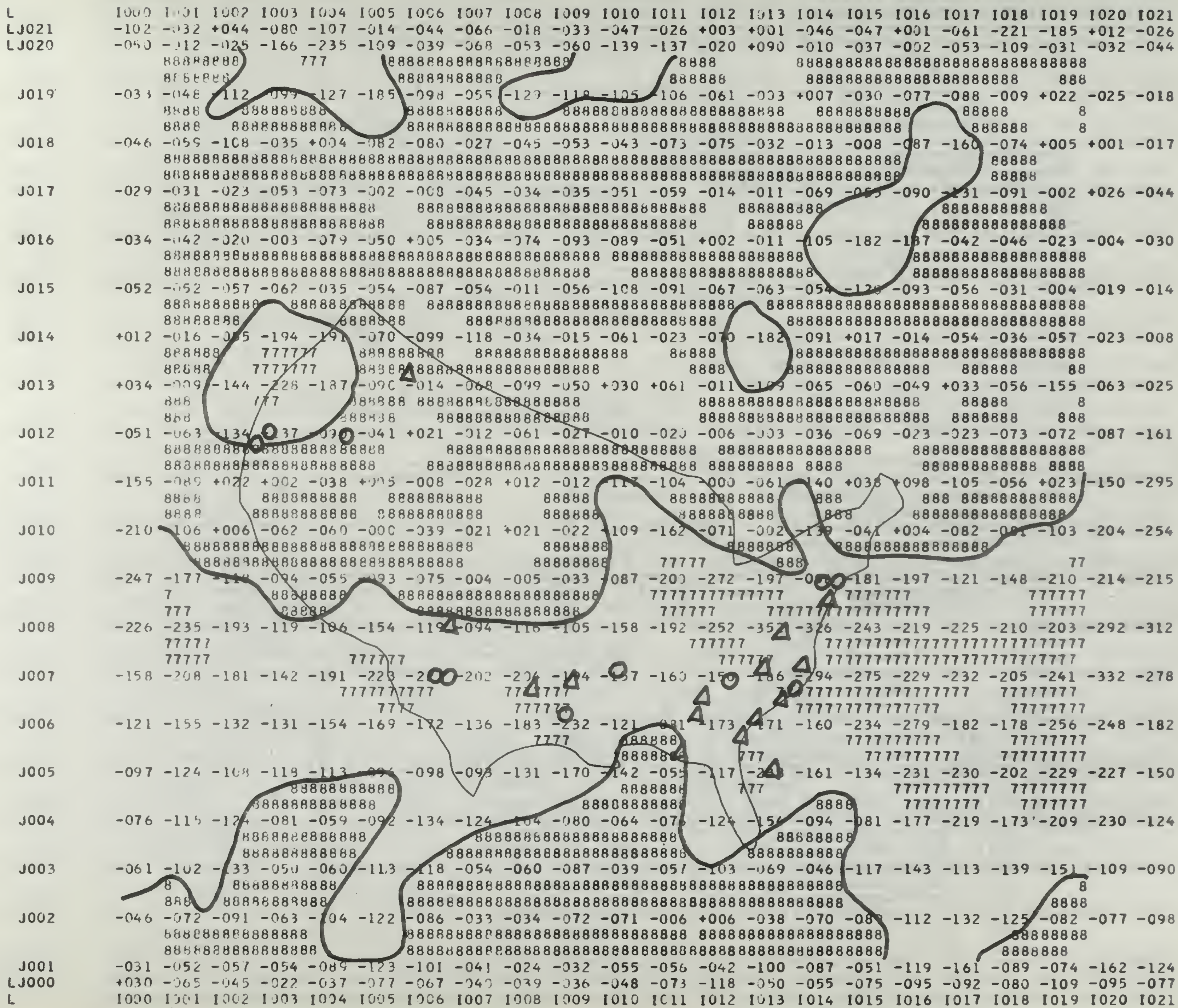
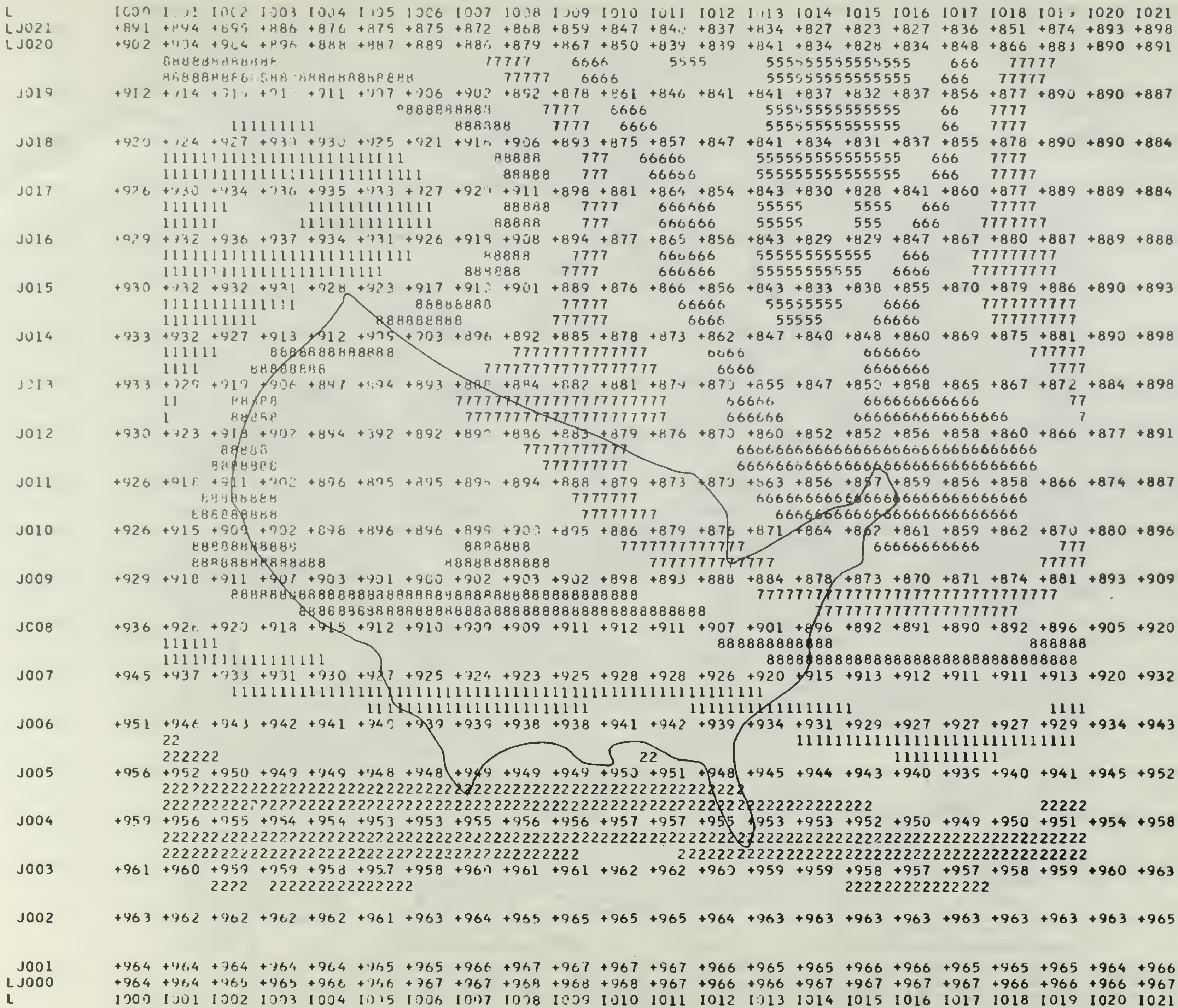
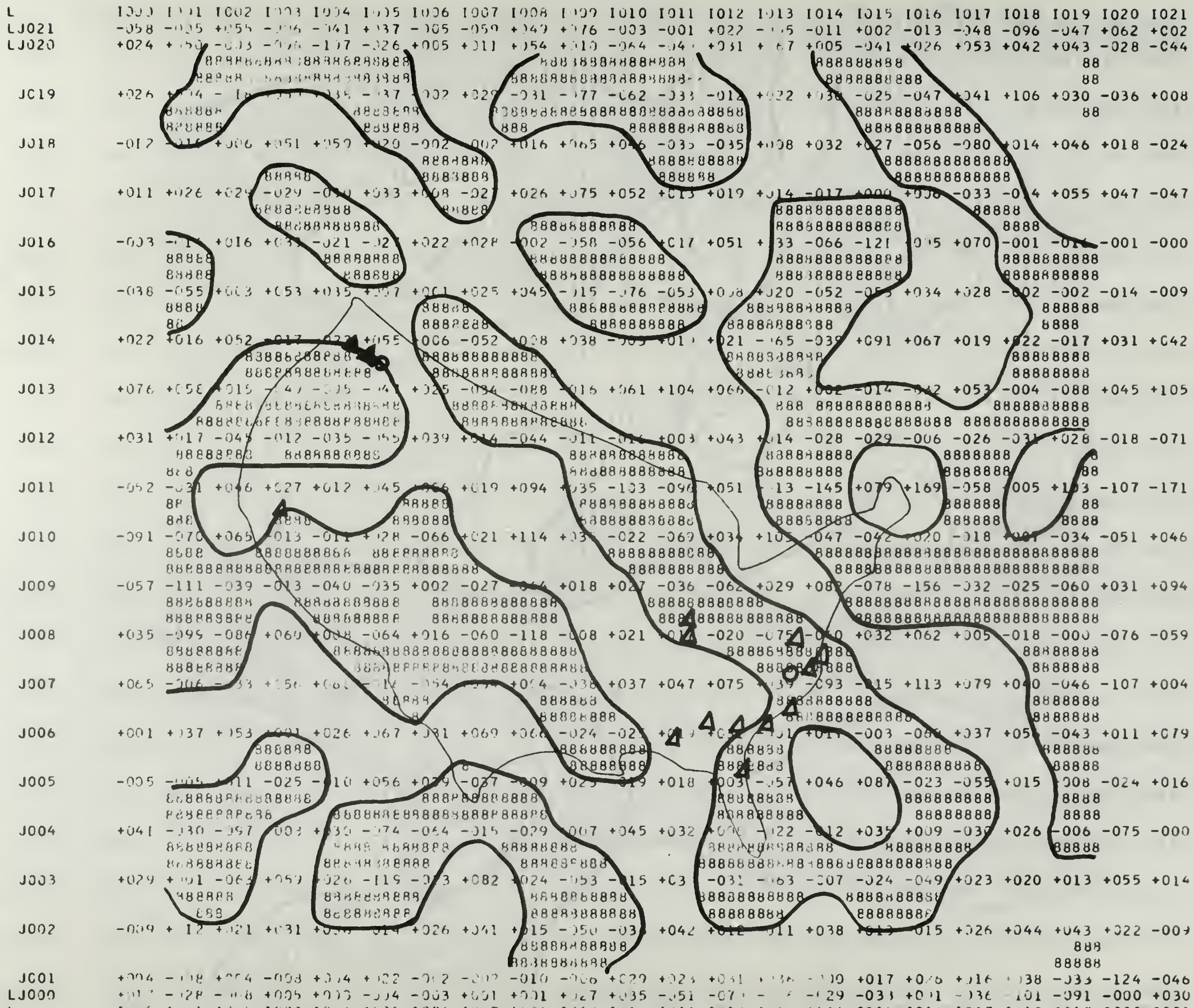


M PREG KAT FIELD LAYER 1 PROG. 24 HOURS 12Z 12 MARCH 1965



LOWER LEVEL Z FIELD LAYER 2 PROG. 24 HOURS 12Z 12 MARCH 1965



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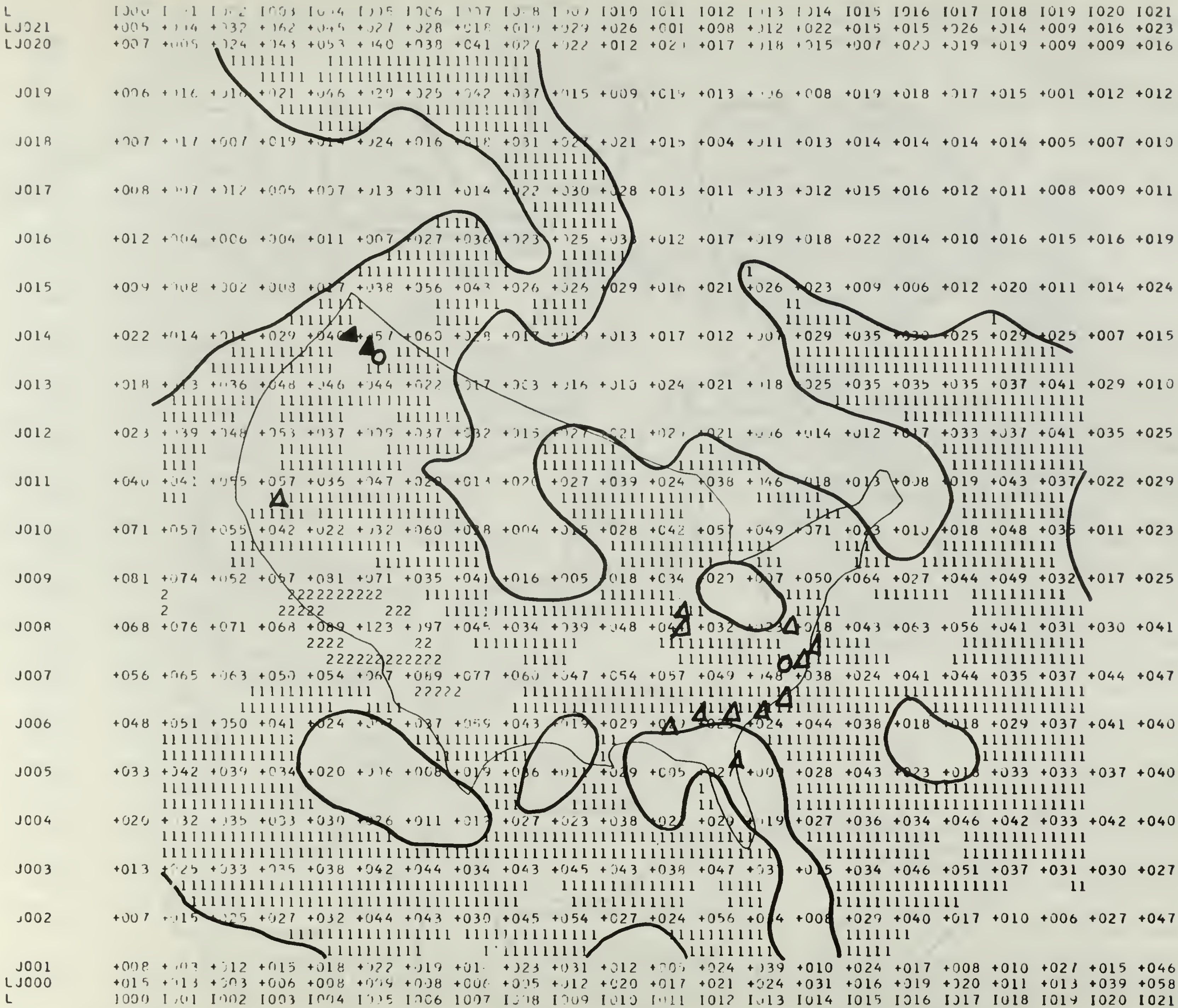
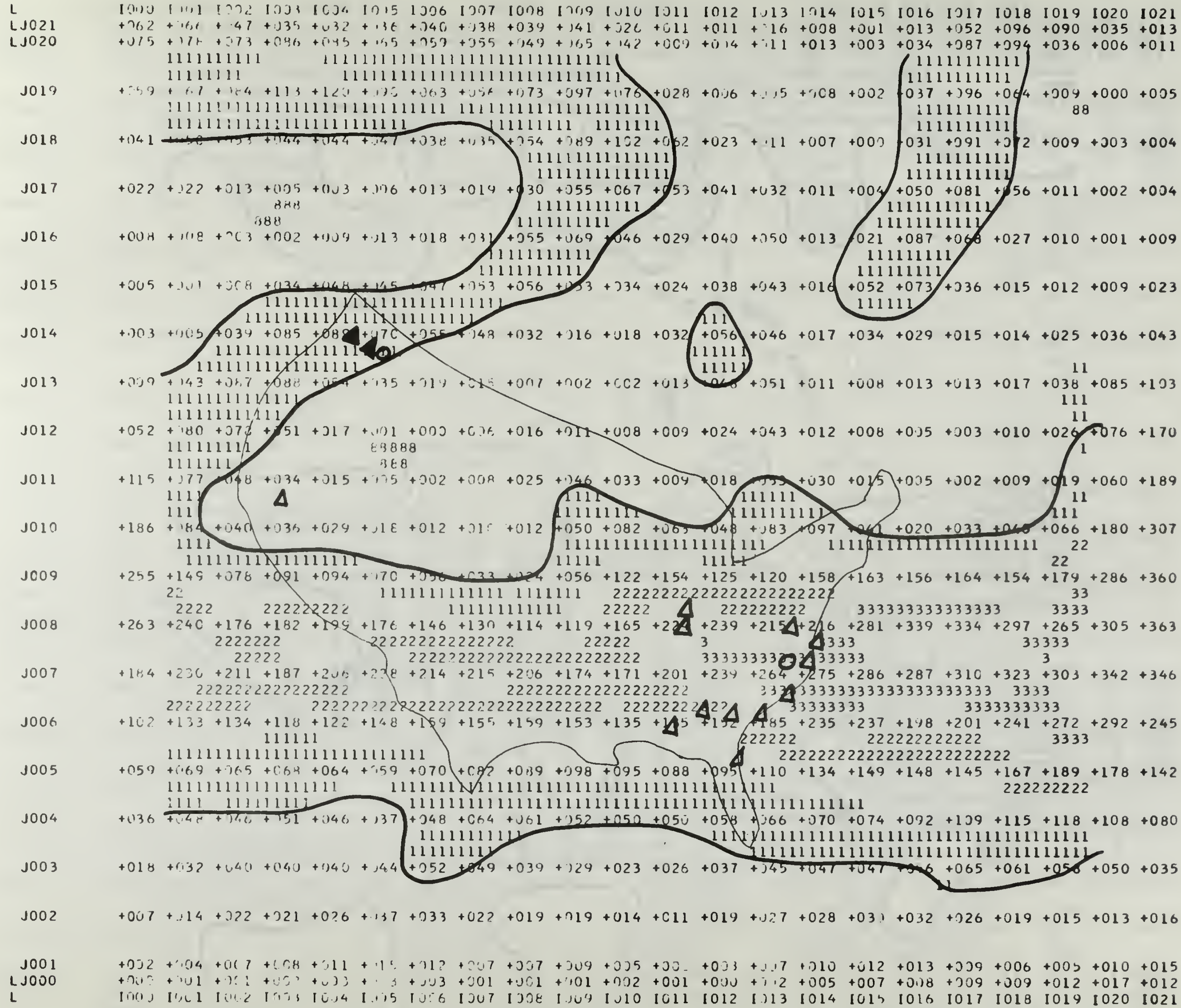


VERT GRAD OF VT LAYER 2 PROG. 24 HOURS 12Z 12 MARCH 1965



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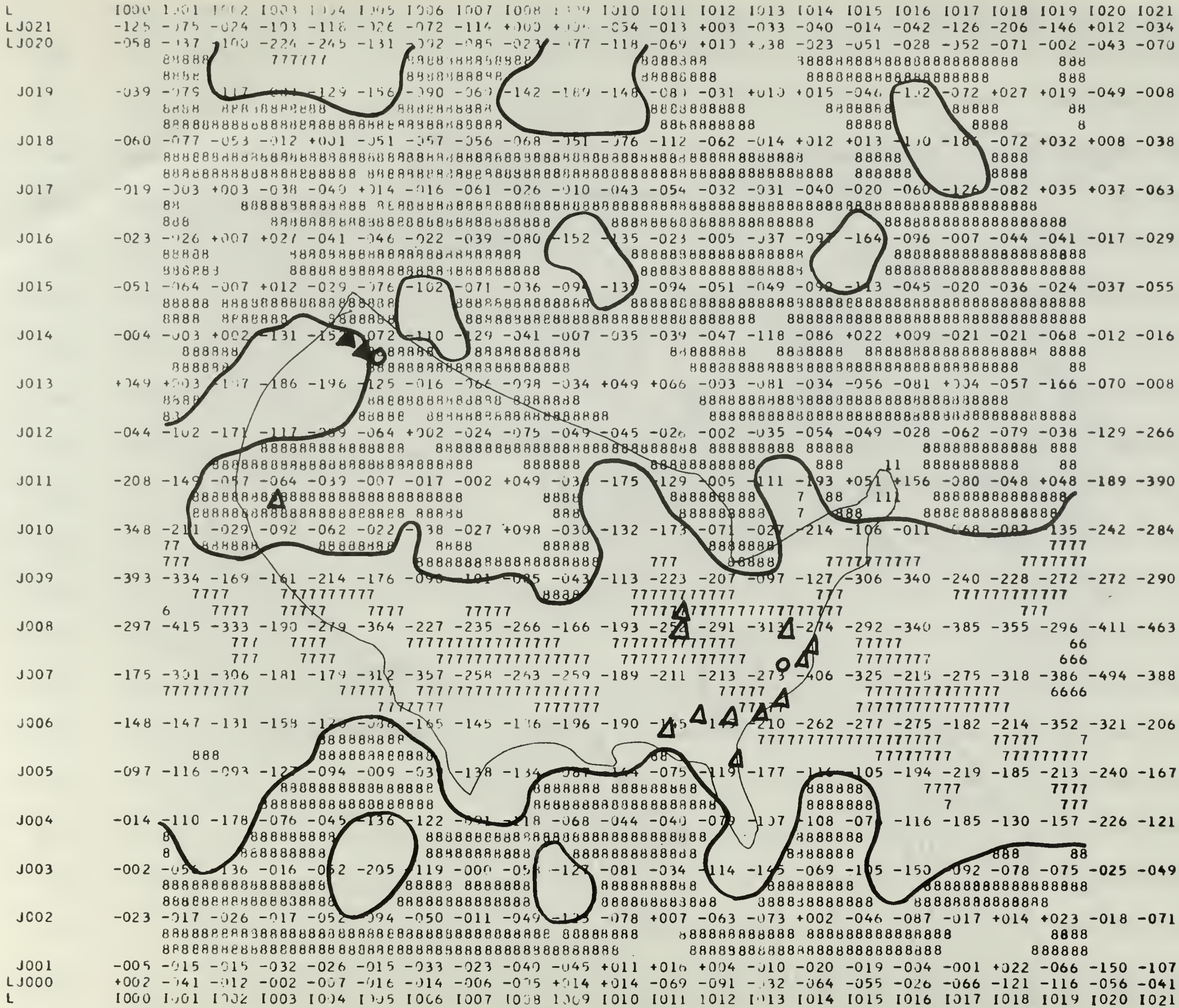

PRCG KAT FIELD LAYER 2 PROG. 24 HOURS 12Z 12 MARCH 1965

TABLE 1

AIRCRAFT TURBULENCE CRITERIA

CATEGORY	DEFINITION
LIGHT	A turbulent condition during which occupants may be required to use seat belts, but objects in the aircraft remain at rest.
MODERATE	A turbulent condition in which occupants require seat belts and occasionally are thrown against the belt. Unsecured objects in aircraft move about.
SEVERE	A turbulent condition in which the aircraft momentarily may be out of control. Occupants are thrown violently against the belt and back into the seat. Objects not secured in the aircraft are tossed about.
EXTREME	A rarely encountered turbulent condition in which the aircraft is violently tossed about, and is practically impossible to control. May cause structural damage to the aircraft.

FIELDS	DATE	TIME	LAYER	TOTAL # OF OCCR	% CORR	L to M		M		M to S		S	
						# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR
LAPLACIAN OF VORTICITY	10 MAR 65	00Z	I	19	79	11	7	6	5	2	1	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	63	11	8	6	4	2	0	0	0
KINETIC ENERGY	"	"	"	"	26	11	3	6	2	2	0	0	0
KAT FIELD	"	"	"	"	32	11	5	6	1	2	[illegible]	[illegible]	0
LAPLACIAN OF VORTICITY	10 MAR 65	"	II	42	67	22	16	16	8	4	4	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	90	22	22	16	12	4	4	0	0
KINETIC ENERGY	"	"	"	"	86	22	19	16	13	4	4	0	0
KAT FIELD	"	"	"	"	76	22	17	16	12	4	3	0	0
LAPLACIAN OF VORTICITY	10 MAR 65	12Z	I	14	71	6	5	5	5	3	3	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	57	6	3	5	2	3	3	0	0
KINETIC ENERGY	"	"	"	"	93	6	6	5	5	3	2	0	0
KAT FIELD	"	"	"	"	71	6	6	5	4	3	0	0	0
LAPLACIAN OF VORTICITY	10 MAR 65	"	II	21	71	15	9	6	6	0	0	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	90	15	13	6	6	0	0	0	0
KINETIC ENERGY	"	"	"	"	90	15	13	6	6	0	0	0	0
KAT FIELD	"	"	"	"	90	15	13	6	5	0	0	0	0

TABLE 2

FIELDS	DATE	TIME	LAYER	TOTAL # OF OCCR	% CORR	L to M		M		M to S		S	
						# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR
LAPLACIAN OF VORTICITY	11 MAR 65	00Z	I	40	68	21	10	13	11	5	5	1	1
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	100	21	21	13	13	5	5	1	1
KINETIC ENERGY	"	"	"	"	67	21	15	13	8	5	4	1	0
KAT FIELD	"	"	"	"	63	21	9	13	9	5	5	1	1
LAPLACIAN OF VORTICITY	11 MAR 65	00Z	II	51	71	31	21	16	11	4	4	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	98	31	30	16	16	4	4	0	0
KINETIC ENERGY	"	"	"	"	88	31	29	16	12	4	4	0	0
KAT FIELD	"	"	"	"	82	31	25	16	13	4	4	0	0
LAPLACIAN OF VORTICITY	11 MAR 65	12Z	I	22	77	14	9	6	6	1	1	1	1
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	86	14	11	6	6	1	1	1	1
KINETIC ENERGY	"	"	"	"	64	14	10	6	4	1	0	1	0
KAT FIELD	"	"	"	"	50	14	8	6	3	1	0	1	0
LAPLACIAN OF VORTICITY	11 MAR 65	12Z	II	5	60	3	3	2	0	0	0	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	80	3	2	2	0	0	0	0	0
KINETIC ENERGY	"	"	"	"	60	3	2	2	1		0	0	0
KAT FIELD	"	"	"	"	40	3	1	2	1	0	[illegible]		[illegible]

TABLE 3

FIELDS	DATE	TIME	LAYER	TOTAL # OF OCCR	% CORR	L to M		M		M to S		S	
						# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR	# OCCR	# CORR
LAPLACIAN OF VORTICITY	12 MAR 65	00Z	I	27	52	11	7	11	6	2	1	3	1
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	92	11	10	11	10	2	2	3	3
KINETIC ENERGY	"	"	"	"	70	11	6	11	10	2	1	3	1
KAT FIELD	"	"	"	"	59	11	7	11	7	2	1	3	1
LAPLACIAN OF VORTICITY	12 MAR 65	00Z	II	19	53	4	2	9	5	5	2	1	1
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	89	4	3	9	8	5	5	1	1
KINETIC ENERGY	"	"	"	"	63	4	1	9	5	5	5	1	1
KAT FIELD	"	"	"	"	48	4	2	9	5	5	2	1	1
LAPLACIAN OF VORTICITY	12 MAR 65	12Z	I	26	77	15	10	11	8	0	0	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	100	15	15	11	11	0	0	0	0
KINETIC ENERGY	"	"	"	"	88	15	13	11	10	0	0	0	0
KAT FIELD	"	"	"	"	92	15	14	11	10	0	0	0	0
LAPLACIAN OF VORTICITY	12 MAR 65	12Z	II	16	81	12	9	2	2	2	2	0	0
VERTICAL GRADIENT OF THERMAL WIND	"	"	"	"	94	12	11	2	2	2	2	0	0
KINETIC ENERGY	"	"	"	"	94	12	11	2	2	2	2	0	0
KAT FIELD	"	"	"	"	87	12	11	2	1	2	2	0	0

TABLE 4

	All Categories	LIGHT TO MODERATE	MODERATE	MODERATE TO SEVERE	SEVERE
TOTAL NUMBER OF KAT OCCURRENCES	302	165	103	28	6
(10 MARCH 1965 TO 12 MARCH 1965)					
PERCENT CORRELATION (BY FIELD AND CATEGORY)					
LAPLACIAN OF VORTICITY		65	71	71	67
VERTICAL GRADIENT OF THERMAL WIND		90	89	93	100
KINETIC ENERGY		70	76	78	33
KAT FIELD		72	70	60	50
PERCENT CORRELATION (BY FIELD)					
LAPLACIAN OF VORTICITY	68				
VERTICAL GRADIENT OF THERMAL WIND	90				
KINETIC ENERGY	76				
KAT FIELD	70				

TABLE 5

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13. ABSTRACT
There is much disagreement as to (a) what causes clear air turbulence (turbulence which is not in or near convective clouds and is above 15,000 feet in altitude) and (b) which meteorological parameters can be used to detect and forecast its occurrence. The approach to this problem has been to relate not one parameter to clear air turbulence but various parameters. By summing these parameters areas can be defined where there is a high probability of encountering clear air turbulence. Each parameter has been based on a statistical study which found a relationship with clear air turbulence. The parameters used were horizontal and vertical shear, curvature, kinetic energy and their derivatives. The numerical forecasting program proposed here can be extended to the stratosphere when more reliable height and temperature fields are available. This program will have much more significance when intermediate forecast height fields, temperature fields and a grid of much smaller mesh length are available.

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14. KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
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Clear Air Turbulence						

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